

REVISION OF THE GENUS *MICROPHIS* KAUP (PISCES: SYNGNATHIDAE)

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ABSTRACT

The gastrophorine (trunk-pouch) pipefish genus *Microphis* Kaup is reviewed, and 5 subgenera and 21 subordinate taxa are recognized. All are restricted to the Indo-Pacific region, except for two Atlantic subspecies of *M. brachyurus*. The genus is characterized by discontinuous superior trunk and tail ridges, by having the lateral trunk ridge confluent with the inferior tail ridge, 9 caudal-fin rays, presence of brood-pouch plates and absence of pouch folds. Juveniles and subadults of some species occur in marine waters, but brooding fish and most others are best represented in freshwaters or low salinity habitats; maximum size approximately 200 mm SL.

The subgenus *Coelonotus* Peters (without ridges on opercle, with or without supplemental body ridges and keeled scutella, with fewer than 5 subdorsal trunk rings) includes *Syngnathus argulus* Peters (Comoro Is. to Marquesas Is.) and *S. leiaspis* Bleeker (Madagascar to Japan). The subgenus *Belonichthys* Peters (with or without keeled scutella; with longitudinal opercular ridge, supplemental body ridges and more than 5 subdorsal trunk rings) includes *Syngnathus fluviatilis* Peters (eastern Africa, Madagascar), *S. mento* Bleeker (Celebes and Philippine Is.), and *Doryichthys spinachioides* Duncker (Papua New Guinea). The subgenus *Microphis* Kaup (with longitudinal opercular ridge and fewer than 4 subdorsal trunk rings; without keeled scutella, supplemental opercular ridges or supplemental body ridges) includes *Syngnathus deocata* Hamilton Buchanan, type-species of the genus *Microphis* (northern India and Bangladesh), *Syngnathus cuncalus* Hamilton Buchanan (India, Sri Lanka, Bangladesh), *Doryichthys dunckeri* Prasad and Mukerji (Irrawaddy R. drainage, Burma), and *Microphis cruentus* Dawson and Fourmanoir (New Caledonia). The subgenus *Oostethus* Hubbs (with longitudinal and supplemental opercular ridges, long snout and fewer than 5 subdorsal trunk rings, but without supplemental body ridges or keeled scutella) includes *Syngnathus manadensis* Bleeker (Indonesia to Taiwan and Solomon Is.), *Microphis pleurostictus* Peters and *M. jagorii* Peters (Philippine Is. endemics), *Doryichthys insularis* Hora (Andaman Is.), and the widespread *Syngnathus brachyurus* Bleeker. Four subspecies of *Microphis brachyurus* are recognized: *M. b. brachyurus* (central Indian Ocean to Japan and Society Is.), *M. b. millepunctatus* (western Indian Ocean), *M. b. aculeatus* (tropical eastern Atlantic), and *M. b. lineatus* (western Atlantic and Pacific terminus of Panama Canal). *Lophocampus* subgen. nov. (with longitudinal and supplemental opercular ridges, short snout, fewer than 2.5 subdorsal trunk rings and usually with supplemental body ridges and/or keeled scutella) is proposed for the accommodation of *Syngnathus retzii* Bleeker, the type-species (Indonesia, Philippine Is. to Samoa), *Doryrhamphus brevidorsalis* de Beaufort (Indonesia, western Caroline Is. to Fiji), *Doryichthys ocellatus* Duncker (Sri Lanka, Indonesia), and *D. caudocarinatus* Weber (Irian Jaya). Included taxa are diagnosed, most are illustrated, complete synonymies are given for all subordinate taxa except *M. b. lineatus* (published elsewhere), distribution maps (based on material examined) are given for Indo-Pacific forms, and a key to subgenera and subordinate taxa is provided.

Among the gastrophorine (trunk-pouch) syngnathids there are two groups of so-called "freshwater" pipefishes which are generally similar in gross morphology and typically have 9 caudal-fin rays. Although juveniles of some species may occur in offshore plankton, subadults-adults are usually found in estuarine or freshwater habitats and brooding males are seldom recorded from marine or high salinity waters. One of these groups, reviewed by Dawson (1981), includes four species of the Indo-Pacific genus *Doryichthys* Kaup, wherein the lateral trunk ridge is not

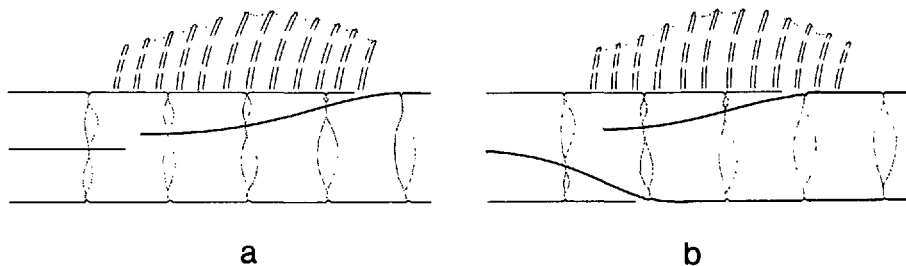


Figure 1. Diagrams illustrating principal body ridge configuration of *Doryichthys* (a) and *Microphis* (b).

confluent with the inferior tail ridge (Fig. 1a). The second group, represented by the genus *Microphis* Kaup and characterized by having the lateral trunk ridge confluent with the inferior tail ridge (Fig. 1b), is treated here.

Nomenclature and taxonomy of most species of *Microphis* have been confused historically, and some have been variously referred to one or more nominal genera. These have never been diagnosed adequately, and some generic characters (e.g., dorsal-fin position, convergence of pouch plates, etc.), considered to be diagnostic by Duncker (1912; 1915), are shared, variable or not substantiated here. This study, based largely on subadults-adults, indicates the presence of five lineages within the genus *Microphis*. These are treated as subgenera in order to emphasize similarities rather than differences between these closely related taxa. Some decisions concerning referral of a species to a subgenus (e.g., *M. spinachioides*) are tentative, due to the paucity of available specimens. Similarly, some taxa treated as species (e.g., *M. dunckeri*) may eventually prove to be best treated as subspecies. Nevertheless, this review provides means for identification of specimens, and establishes a basis for further study of the 18 species included in the genus *Microphis*.

METHODS AND MATERIALS

Measurements are in millimeters (mm) and some are referred to standard length (SL), total length (TL) or head length (HL); measurements of damaged specimens (*) refer to present overall length. As employed here, the term "venter" refers to the ventral surface; anal ring is the ring bearing the anus; keeled scutella are those bearing a longitudinal keel-like ridge; supplemental body ridges (Fig. 2) are ridge-like ornamentations of rings, usually extending between scutella, which develop between the principal body ridges in subadults-adults of some species; supplemental opercular ridges are prominent ridges which radiate above and/or below the longitudinal opercular ridge in some species; color descriptions are largely confined to distinctive markings of specimens preserved in alcohol; other methods are those of Dawson (1977). Species synonymies are intended to be complete, but some references may have been omitted inadvertently. Meristic data for *M. brachyurus* ssp. and the synonymy of *M. b. lineatus* have been published elsewhere (Dawson, 1979; 1982a) and are omitted here. Some meristic data have been grouped for convenience of presentation (Tables 5, 7-9) and these may not agree exactly with counts given in text. The key and diagnoses are largely based on subadult-adult characters, and species comparisons are confined to taxa within the same subgenus. Materials examined are listed by general locality from west to east and roughly north to south; depths and altitudes are in meters (m); maps, based on material examined, delineate general localities and each symbol represents one or more collections.

Abbreviations for repositories of materials examined are: AMNH—American Museum of Natural History, New York; AMS—Australian Museum, Sydney; ANSP—Academy of Natural Sciences of Philadelphia; BMNH—British Museum (Natural History), London; BPBM—Bernice P. Bishop Museum, Honolulu; CAS—California Academy of Sciences, San Francisco; CAS-SU—Stanford University collections, now at CAS; FMNH—Field Museum of Natural History, Chicago; UF—University of Florida, Florida State Museum, Gainesville; GCRL—Gulf Coast Research Laboratory Museum;

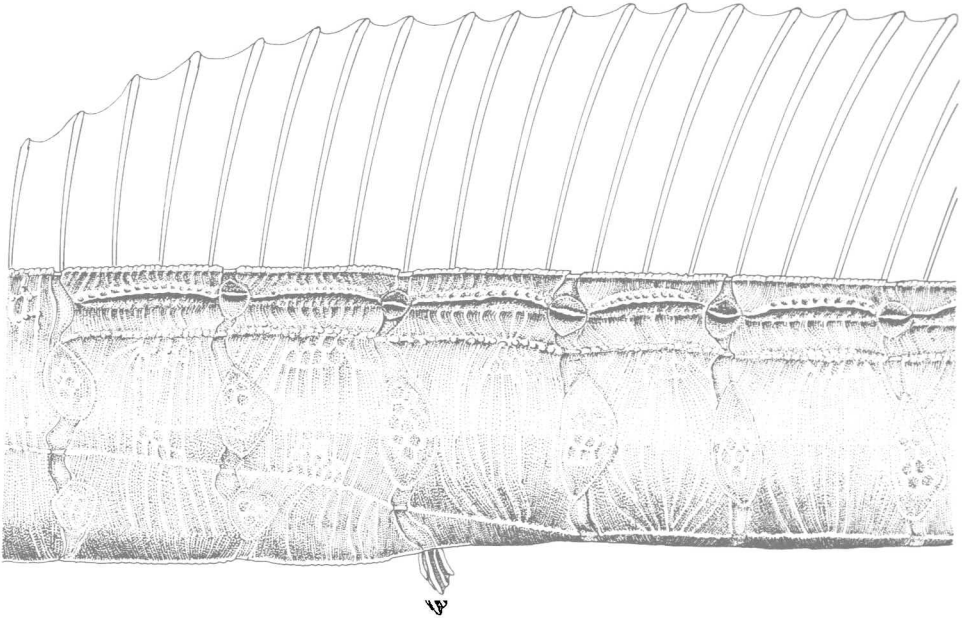


Figure 2. Section illustrating part of dorsal fin and subdorsal portion of body of an adult specimen of *Microphis argulus*. Note keeled scutella and supplemental ridge between superior ridge and lateral tail ridge.

IORO—Institute of Oceanic Research and Development, Tokai University, Orido; IRSNB—Institute Royal des Sciences Naturelles de Belgique, Brussels; IZT—Institute of Zoology, Academia Sinica, Taipei; KFRS—Kanudi Fisheries Research Station, Konedobu, Papua New Guinea; MCZ—Museum of Comparative Zoology, Harvard University; MNHN—Muséum National d'Histoire Naturelle, Paris; NMC—National Museum of Canada, Ottawa; NMW—Naturhistorisches Museum Fischsammlung, Wien; QM—Queensland Museum, Brisbane; RMNH—Rijksmuseum van Natuurlijke Historie, Leiden; RUSI—J. L. B. Smith Institute of Ichthyology, Grahamstown; SMF—Natur-Museum und Forschungs-Institute Senckenberg, Frankfurt am Main; UMMZ—University of Michigan Museum of Zoology, Ann Arbor; USNM—National Museum of Natural History, Smithsonian Institution, Washington, D.C.; USP—University of the South Pacific, Fiji; UWCF—University of Washington, College of Fisheries, Seattle; WAM—Western Australian Museum, Perth; YCM—Yokosuka City Museum; ZMA—Zoölogisch Museum, Amsterdam; ZMB—Zoologisches Museum, Museum für Naturkunde der Humboldt-Universität, Berlin; ZMUC—Zoologisk Museum, University of Copenhagen; ZSI—Zoological Survey of India, Calcutta.

Genus *Microphis* Kaup

Synonymy.—See subgenera.

Diagnosis.—Superior trunk and tail ridges discontinuous near vertical through rear of dorsal-fin base, not arched dorsad on subdorsal rings; lateral tail ridge ends on trunk, usually near vertical through dorsal-fin origin; inferior trunk and tail ridges discontinuous; lateral trunk ridge deflected ventrad near anal ring and confluent with inferior tail ridge (Fig. 1b); venter of trunk more or less V-shaped in adult females, the median ridge distinct or low and inconspicuous; median dorsal snout ridge low, entire, usually ends near vertical through rear of nares, sometimes continued on interorbital; lateral snout ridge sometimes straight, usually arched dorsad; anterior supraorbital ridges usually end near vertical through middle of orbit, sometimes confluent with posterior supraorbital ridges; prenuchal, nuchal and frontal ridges low to a little elevated, the frontal ridge sometimes

vestigial or obsolete; typically with a ridge above gill opening, with or without one or more low supraopercular ridges; opercle with or without a complete longitudinal ridge, with or without supplemental ridges above and/or below longitudinal ridge, otherwise ornamented with minute striae; pectoral-fin base not protruding strongly laterad, with or without prominent superior and inferior ridges; principal body ridges low to somewhat elevated, notched or indented between rings, the margins entire, denticulate or serrate at $\times 30$ magnification; posterior angles of rings sometimes produced to spine-like points; scutella with or without longitudinal keel-like ridges; without dermal flaps; dorsal-fin origin on trunk, its base not elevated; pectoral fin rounded to clearly emarginate with median rays shorter than those above and below. Head length 4.2–11.7 in SL, snout length 1.4–2.8 in HL, length of dorsal-fin base 0.4–1.9 in HL; trunk rings 15–22; total rings 39–55; total subdorsal rings 5.25–16.5; dorsal-fin rays 25–74; pectoral-fin rays 15–23; anal-fin rays usually 4; caudal-fin rays typically 9. Brood pouch originates on 1st–3rd trunk ring; pouch plates well developed, with or without narrow membranes on distal margins; pouch plates vertical or perpendicular to strongly convergent, the pouch eggs variably exposed to completely concealed by convergent pouch plates; eggs deposited in 1–14 transverse rows, in 1–2 layers, dorsum of pouch with membranous egg-compartments in brooding males. Without odontoid processes in jaws (Dawson and Fritzsche, 1975) or bony inclusions in gill membranes or sclera of eye (Dawson, 1978; 1982b).

Comparisons.—Among gastrophorine genera, the principal body ridge configuration of *Microphis* (Fig. 1b) is shared only with the genus *Doryrhamphus* Kaup (including the subgenera *Doryrhamphus* and *Dunckerocampus* Whitley). *Microphis* is distinguished by having 9 rather than the 10 caudal-fin rays typical of *Doryrhamphus*, by having an entire rather than denticulate to spiny median dorsal snout ridge, by the absence of prominent spines on the principal trunk ridges of subadults-adults, and by failing to have the 1st trunk ring conspicuously longer than the 2nd (usually much longer in *Doryrhamphus*). Additionally, species of *Microphis* commonly frequent estuarine and freshwater habitats, whereas species of *Doryrhamphus* are predominantly stenohaline, and the prominent striped or banded coloration common to most species of *Doryrhamphus* is not found in species of *Microphis*. The *Microphis* ridge configuration is shared with a number of urophorine (tail-pouch) genera, but only *Trachyrhamphus* Kaup shares the count of 9 caudal-fin rays. *Microphis* further differs from this genus in having fewer total rings (39–55 versus 64–86), and in lacking the dermal flaps and elongate 1st trunk ring present in *Trachyrhamphus*.

Subgenera.—Species included here have usually been referred to eight nominal genera: *Microphis* Kaup, 1853, *Coelonotus* Peters 1855, *Doryichthys* Kaup 1856, *Belonichthys* Peters, 1868, *Doryichthys* Duncker 1910, *Microphis* Duncker 1910, *Oostethus* Hubbs, 1929, *Paramicrophis* Klausewitz 1955. Of these, *Microphis* Duncker and *Doryichthys* Duncker are junior homonyms of Kaup's earlier names, *Paramicrophis* is here considered a junior synonym of *Microphis* Kaup, and I have shown (Dawson, 1981) that the principal body ridge configuration of *Doryichthys* Kaup differs from that of *Microphis* Kaup. The remaining nominal genera (*Belonichthys*, *Coelonotus*, *Microphis*, *Oostethus*) are treated here as subgenera and, together with a new subgenus (*Lophocampus*), serve to distinguish five species groups within the genus *Microphis* Kaup. The 21 subordinate taxa included therein represent a group of pipefishes characterized by a common principal body ridge configuration, typically 9 caudal-fin rays, presence of brood-pouch plates and location of brood pouch under the trunk.

Table 1. Selected characters distinguishing subgenera of the genus *Microphis*, together with numbers of recognized subordinate taxa

Character	<i>Coelonotus</i>	<i>Belonichthys</i>	<i>Microphis</i>	<i>Oostethus</i>	<i>Lophocampus</i>
Longitudinal opercular ridge complete	—	+	+	+	+
Supplemental opercular ridges present	—	—	—	+	+
Lateral and inferior trunk ridges distinct	—	+	+	+	+
Supplemental body ridges present	±	±	—	—	±
Keeled scutella present	±	±	—	—	±
Trunk rings	16–18	16–20	15–18	17–22	15–20
Tail rings	30–39	21–27	24–33	20–33	26–32
Dorsal-fin rays	42–63	59–74	27–57	27–54	25–42
Subdorsal trunk rings	4.5–2.5	12.0–5.25	3.75–0.25	4.0–0.25	2.0–0.25
Subdorsal tail rings	7.5–9.25	3.0–6.75	4.5–7.5	4.0–8.75	3.75–9.0
Pectoral-fin rays	15–20	15–20	16–22	17–23	16–21
HL in SL	8.1–11.7	5.4–9.4	6.4–10.4	4.2–10.0	6.9–10.7
Snout length in HL	2.2–2.7	2.3–2.8	1.4–2.4	1.5–2.3	2.1–2.7
Snout depth in snout length	2.5–4.9	2.2–4.8	4.4–7.9	3.8–13.2	2.8–5.0
Number of species	2	3	4	5	4
Number of subspecies	0	0	0	4	0

The subgenera of *Microphis* overlap in most meristic and morphometric features (Table 1), but they are distinguished by differences in the subadult-adult state of the following characters:

1. *Longitudinal opercular ridge*.—This ridge is typically complete and well developed in representatives of *Microphis*, *Oostethus* and *Lophocampus*. It is usually complete but indistinct in *Belonichthys*, whereas it is absent or vestigial in *Coelonotus*.

2. *Supplemental opercular ridges*.—Absent below the longitudinal ridge in representatives of *Microphis*, *Coelonotus* and *Belonichthys*, but occasional specimens of some species of *Microphis* may have a supplemental ridge above the longitudinal ridge. Supplemental opercular ridges are typically present below the longitudinal ridge and often present above the ridge in representatives of *Oostethus* and *Lophocampus*.

3. *Lateral and inferior trunk ridges*.—Well developed and prominent in all subgenera except *Coelonotus*.

4. *Supplemental body ridges and keeled scutella*.—Absent in *Microphis* and *Oostethus*; variously present or absent in species referred to other subgenera.

Duncker (1910; 1912; 1915) employed apparent differences in brood-pouch morphology in diagnosing *Coelonotus*, *Belonichthys* and his *Microphis* and *Doryichthys*. Pouch plates were described as ventrally divergent in *Microphis*, but ventrally convergent in *Coelonotus*, *Belonichthys* and *Doryichthys*. Additionally, Duncker (1912) stated that the distal margins of the pouch plates were united by a longitudinal membrane in *Coelonotus* and *Belonichthys*, and sometimes so united in *Doryichthys* Duncker. Later, Duncker (1915) diagnosed pouch plates as usually united by a membrane in *Doryichthys* Duncker and probably united by a membrane in *Belonichthys*. I find that the orientation of pouch plates in these pipefishes is determinable only in brooding males, that none of those examined here have divergent plates, and that orientation varies from vertical or perpen-

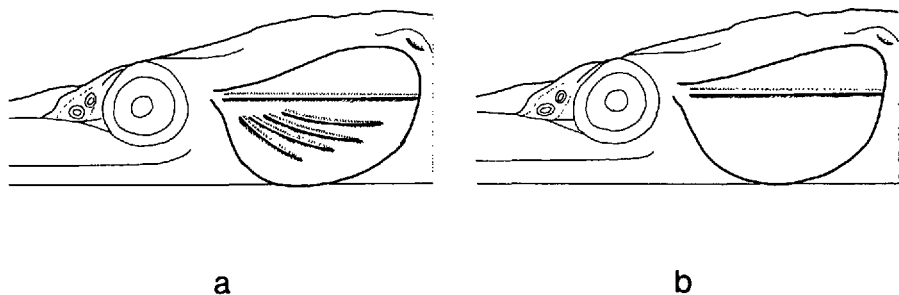


Figure 3. Diagrams illustrating two variations in opercular ornamentation in subgenera and species of *Microphis*: a, with supplemental ridges below longitudinal ridge; b, without supplemental ridges.

dicular to strongly convergent. Plates are slightly to moderately convergent, but not united by a membrane, in two species of the subgenus *Belonichthys* (*fluviatilis*, *spinachioides*), and in both species of the subgenus *Coelonotus*. Within the subgenera *Microphis* and *Oostethus*, plates of examined brooding males are perpendicular in some species but somewhat convergent in others. In neither case are the plates united by a membrane. Pouch plates are most strongly convergent in three species of the subgenus *Lophocampus* (*retzii*, *brevidorsalis*, *ocellatus*) wherein brooding males have been examined. In these, the plates meet or nearly meet on the ventral midline of the pouch, thereby concealing or almost concealing (or enclosing) the brood-pouch eggs. Distal margins of the plates are separate in most individuals, but marginal membranes may be interlocked or seemingly united in occasional specimens of *Microphis retzii*. In view of substantial variations in the orientation of pouch plates, differences in pouch morphology are not considered primary diagnostic characters of subgenera of *Microphis*. Differences between the subgenera are not strong, but subgenera are employed here to indicate intrageneric relationships and the general similarity of included taxa.

Remarks.—Fritzsche (1980) discussed differences in the branchial skeleton of representatives of several genera of pipefishes, and suggested that such differences may be useful in determining generic relationships. I have not examined the branchial skeleton of all species treated here. However, all branchial elements except the 3rd basibranchial are present in single cleared and stained specimens of six species (*M. brachyurus*, *M. brevidorsalis*, *M. cruentus*, *M. fluviatilis*, *M. manadensis*, *M. retzii*).

Dorichthys (sic) *heraldi* Menon, a nomen nudum introduced by Menon and Yazdani (1968) and cited by Sen (1980), is probably referable to a species of *Microphis*, but specimens were not available for study and the name is omitted from present synonymies. This name may have originated with a juvenile specimen from the Gadilam River (India) which was listed as "*Doryichthys* sp." by Menon (1961). However, the specimen reported by Menon and Yazdani (1968) is listed from the Ponnayar R.

Size.—The largest specimen examined is 206 mm SL.

Distribution.—All included taxa, except for two Atlantic subspecies of *Microphis brachyurus*, are distributed within the Indo-Pacific area bounded by the coast of Africa in the west, the Marquesas Is. in the east, South Africa (Durban) in the south and Japan (Honshu I.) in the north. Juveniles and subadults may occur in

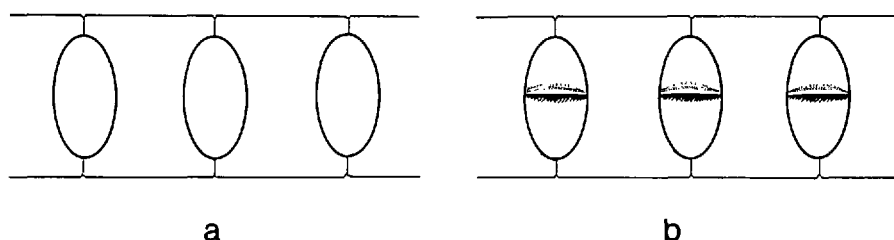


Figure 4. Diagrams illustrating principal variations in ornamentation of scutella in subgenera and species of *Microphis*: a, scutella without longitudinal ridge; b, scutella with longitudinal keel-like ridge (keeled scutella).

oceanic and estuarine localities, but juveniles and adults of all taxa are apparently most common in freshwater streams and/or rivers.

KEY TO SUBGENERA AND SUBORDINATE TAXA OF *Microphis*

- 1a. Longitudinal opercular ridge usually distinct and complete, lateral and inferior trunk ridges distinct, tail rings 20–33 3
- 1b. Longitudinal opercular ridge absent or vestigial, lateral and inferior trunk ridges indistinct, tail rings 30–39 (subgenus *Coelonotus*) 2
- 2a. Trunk rings 16 (in 97% examined), tail rings 36–39, specimens above 100 mm SL with dark spots on pectoral-fin base and ocellate spots on lateral scutella of trunk *argulus*
- 2b. Trunk rings 17 (in 95%), tail rings 31–34, without dark spots on pectoral-fin base or ocelli on trunk *leiaspis*
- 3a. Opercle with one or more supplemental ridges below longitudinal ridge (Fig. 3a) 4
- 3b. Opercle without supplemental ridges below longitudinal ridge (Fig. 3b) 15
- 4a. Snout relatively long and slender, its depth averages 4.3–10.6 in snout length; scutella (Fig. 4a) without keel-like ridges (subgenus *Oostethus*) 5
- 4b. Snout relatively shorter and deeper, its depth averages 3.5–4.1 in snout length; often with keel-like ridges (Fig. 4b) on scutella (*Lophocampus* subgen. nov.) 12
- 5a. Snout length averages 1.6–1.7 in HL, snout depth averages 8.7–10.6 in snout length (*M. brachyurus* ssp.) 6
- 5b. Snout length averages 1.9–2.2 in HL, snout depth averages 4.3–6.7 in snout length 9
- 6a. Trunk rings 19–22 (20 or more in 98%), eastern Atlantic, Indian and Pacific oceans 7
- 6b. Trunk rings 17–21 (19 or fewer in 94%), western Atlantic Ocean and Pacific coast of Panama *b. lineatus*
- 7a. Trunk rings usually 20 (88%), eastern Atlantic and western Indian Ocean 8
- 7b. Trunk rings usually 21 (92%), central Indian Ocean to central Pacific Ocean *b. brachyurus*
- 8a. Total rings 41–44 ($\bar{x}$ = 43.0), dorsal-fin rays 41–51 ($\bar{x}$ = 46.4), subdorsal trunk rings 3.5–1.75 ($\bar{x}$ = 2.5), eastern Atlantic Ocean *b. aculeatus*
- 8b. Total rings 39–44 ($\bar{x}$ = 41.0), dorsal-fin rays 40–45 ($\bar{x}$ = 42.1), subdorsal trunk rings 2.5–0.75 ($\bar{x}$ = 2.0), western Indian Ocean *b. millepunctatus*
- 9a. Tail rings 21–26 10
- 9b. Tail rings 30–33 *insularis*
- 10a. Trunk rings modally 20–21 11
- 10b. Trunk rings modally 18 *pleurostictus*
- 11a. Trunk rings modally 20, dorsal-fin rays 33–40, snout depth averages 5.8 in snout length *jagorii*
- 11b. Trunk rings modally 21, dorsal-fin rays 37–44, snout depth averages 6.7 in snout length *manadensis*
- 12a. Trunk rings 15–17 13
- 12b. Trunk rings 20 *caudocarinatus*
- 13a. Dorsal-fin rays 32–42 14
- 13b. Dorsal-fin rays 25–29 *brevadorsalis*
- 14a. Keeled scutella usually present on side of tail, often present on dorsum and side of trunk; without ocelli on side of trunk *retzii*

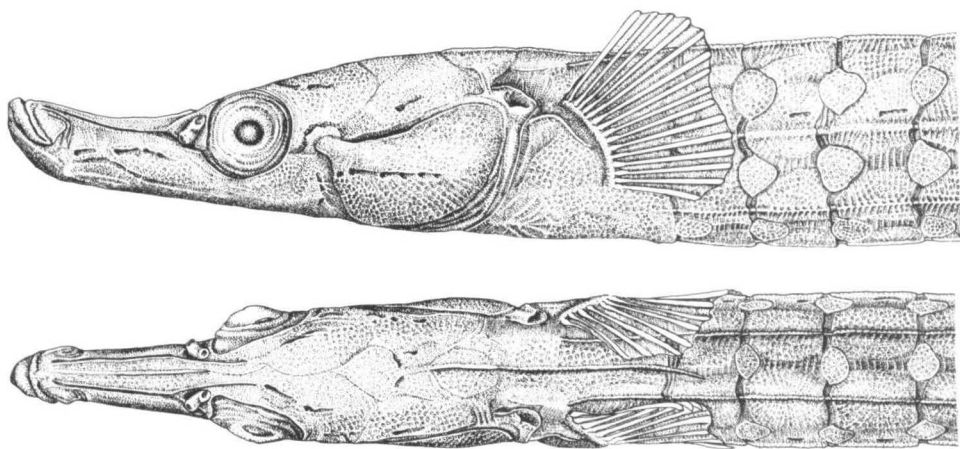


Figure 5. *Microphis argulus*. Lateral and dorsal aspects of head and anterior trunk rings. From 113 mm SL female (USP uncat.).

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|---|---------------------|
| 14b. Keeled scutella absent or restricted to dorsum of 1st-2nd trunk ring, with ocelli on lateral trunk ridge | <i>ocellatus</i> |
| 15a. Subdorsal trunk rings less than 4.0, without supplemental body ridges or keeled scutella (subgenus <i>Microphis</i>) | 16 |
| 15b. Subdorsal trunk rings more than 5.0, with or without supplemental body ridges and/or keeled scutella (subgenus <i>Belonichthys</i>) | 19 |
| 16a. Tail rings 29-33 | 17 |
| 16b. Tail rings 24-27 | 18 |
| 17a. HL averages 7.4 in SL, snout depth averages 7.2 in snout length, without ocelli on lateral trunk ridge | <i>deocata</i> |
| 17b. HL averages 9.4 in SL, snout depth averages 5.2 in snout length, with ocelli on lateral trunk ridge | <i>cruentus</i> |
| 18a. Dorsal-fin rays 29-32, HL averages 6.7 in SL, snout depth averages 7.2 in snout length | <i>dunckeri</i> |
| 18b. Dorsal-fin rays 47-56, HL averages 8.2 in SL, snout depth averages 5.8 in snout length | <i>cunclus</i> |
| 19a. Trunk rings 17-20, subdorsal trunk rings 12.0-10.0 | 20 |
| 19b. Trunk rings 16, subdorsal trunk rings 6.0-5.5 | <i>spinachoides</i> |
| 20a. Snout depth averages 2.9 in snout length, tail rings 21-23 | <i>mento</i> |
| 20b. Snout depth averages 4.0 in snout length, tail rings 23-26 | <i>fluvialis</i> |

Subgenus *Coelonotus* Peters

Hemimarsupium Kaup, 1853: 234 (nomen nudum; type-species, *Typhlus Goudotii* Bibron MS, by monotypy).

Coelonotus Peters, 1855a: 278 (type-species, *Syngnathus argulus* Peters, 1855a [= *S. argus* (not of Richardson, 1840) Peters, 1852], by original designation).

Hemithylacus Kaup, 1856: 61 (type-species, *Syngnathus leiaspis* Bleeker, 1853, by monotypy).

Diagnosis.—Longitudinal opercular ridge absent or vestigial; without supplemental opercular ridges; with or without supplemental body ridges and keeled scutella; lateral and inferior trunk ridges indistinct; with or without prominent ridges on pectoral-fin base, fin rounded to a little emarginate; pouch plates a little convergent in brooding males; brood-pouch eggs in 2-6 or more transverse rows; snout depth 2.5-4.9 in snout length; tail rings 30-39; total subdorsal rings 10.5-13.0.

Comparisons.—See characters in key, diagnoses and discussion of subgenera.

Remarks.—The superior trunk and tail ridges are distinct and a little elevated



Figure 6. Top: *Microphis argulus* (Peters), adult female, 113 mm SL (USP uncat.). Middle and Bottom: *M. leiaspis* (Bleeker), GCRL 17470. Middle.—Adult female, 159.5 mm SL. Bottom.—Ventral aspect of pouch of brooding male, 149 mm SL, with eggs and larvae in situ.

above the intervening dorsum, whereas the lateral and inferior trunk ridges are indistinct and the ventrolateral portion of the trunk is somewhat rounded. Some subadults-adults may have a faint incomplete opercular ridge, margined below by 2–3 pit-like depressions, but the ridge is absent in most specimens examined. A specimen of *Microphis leiaspis* (80 mm SL) from an oceanic plankton sample has a complete opercular ridge and this ridge is probably distinct and complete in early juveniles (<50 mm SL).

Duncker (1912; 1915) diagnosed *Coelonotus* as having the pouch plates united by a distal marginal skin-fold or membrane, and implied that the convergent plates enclosed or concealed the brood-pouch eggs. Pouch plates of brooding males examined here are free, except for a short transverse membrane before the anus. The plates seldom conceal more than the outermost longitudinal rows of eggs.

Microphis (Coelonotus) argulus (Peters)

Figures 5 and 6

Syngnathus argus (not of Richardson) Peters, 1852: 685 (orig. descr.; Anjoana I., Comoro Is.).

Syngnathus argulus Peters, 1855a: 278 (replacement name for *S. argus* Peters, preoccupied; type-species of *Coelonotus*).

? *Syngnathus micrognathus* Kaup, 1856: 27 (nomen nudum).

? *Syngnathus compressus* Kaup, 1856: 27 (nomen nudum).

Coelonotus (Syngnathus) argulus Peters, 1868: 106, pl. 20, fig. 4 (n. comb., descr.).

Coelonotus argulus. Duméril, 1870: 541 (characters compiled); Günther, 1870: 189 (synon., characters); Bleeker, 1874: 75 (compiled); Sauvage, 1891: 528 (compiled); Boulenger, 1915: 84, fig. 70 (in key, characters); Jordan, 1919: 266 (compiled); Pellegrin, 1933: 188 (in key, sinon., descr.; Madagascar); Herre, 1936: 80 (synon., descr.; stream near Atuona, Hiva Oa, Marquesas Is.);

Table 2. Frequency distributions of trunk rings in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Trunk Rings							
	15	16	17	18	19	20	21	22
<i>Coelonotus</i>								
<i>argulus</i>		35	1					
<i>leiaspis</i>		3	71	1				
<i>Belonichthys</i>								
<i>fluviatilis</i>				1	44	1		
<i>mento</i>			1	3	6			
<i>spinachioides</i>		5						
<i>Microphis</i>								
<i>deocata</i>	2	3	1					
<i>dunckeri</i>			4					
<i>cruentus</i>		2	22	2				
<i>cuncalus</i>		1	36	8				
<i>Oostethus</i>								
<i>manadensis</i>						3	18	1
<i>pleurostictus</i>			4	9				
<i>insularis</i>			1	49	7			
<i>jagorii</i>				2	24	47	1	
<i>Lophocampus</i>								
<i>retzii</i>	1	116	1					
<i>ocellatus</i>	1	8	2					
<i>brevadorsalis</i>	2	21						
<i>caudocarinatus</i>						1		

Fowler, 1938: 275 (compiled); Fowler, 1949: 65 (compiled); Arnoult, 1959: 35, pl. 5 (synon., descr., Madagascar); Smith, 1963: 528, pl. 77, fig. H (in key, synon., characters, range); Baissac, 1976: 198 (compiled); Mauge, 1978: 95, fig. 1 (comparisons, proposal of subspecies, not definitely recorded from Madagascar); Ryan, 1980: 61 (Taveuni, Fiji Is.); Ryan, 1981: 93 (characters).

Syngnathus platyrhynchus Dumeril, 1870: 568, 571 (in key; orig. descr., Noukahiva [Nuku Hiva, Marquesas Is.]).

Coelonotus biocellatus Günther, 1870: 188 (orig. descr.; "East-Indian archipelago"); Duncker, 1915: 56 (=C. argus); Smith, 1963: 528 (data from orig. descr.); Mauge, 1978: 97 (comparisons, range).

Syngnathus muraena (not of Kaup) Sauvage, 1891: 528, pl. 50, fig. 4 (misident., Madagascar); Duncker, 1915: 56 (possibly = *Coelonotus argus*); Mauge, 1978: 95, fig. 1 (remarks on spec. figured by Sauvage).

Coelonotus argus. Duncker, 1912: 230 (n. comb., type-species of *Coelonotus*); Duncker, 1915: 56 (synon., descr., range); Weber and de Beaufort, 1922: 57 (in key, synon., descr., range); Bertin and Estéve, 1950: 44 (incorrectly, as sr. syn. of *Syngnathus muraena* Kaup).

Coelonotus platyrhynchus. Duncker, 1915: 56 (n. comb., misspelling, descr.); Duncker and Mohr, 1925: 107, pl. 2, fig. 3 (intermediate between *C. argus* and *C. liaspis* in numerical features; freshwater; New Pomerania [=New Britain], Solomon Is.).

Coelonotus platyrhynchus. Fowler, 1928: 111 (refs., characters, range); Fowler, 1932a: 7, fig. 2 (descr.; Ua Huka, Marquesas Is.); Fowler, 1932b: 6 (notes on eggs, etc.; Fatu Hiva and Ua Pou, Marquesas Is.); Munro, 1958a: 143 (refs. compiled); Munro, 1967: 153, 155, pl. 17, fig. 255 (in key, descr., estuarine); Randall, 1973: 182 (Tahitian name, note); Kähnsbauer, 1974: 275, 278 (characters; Rossel I., Papua New Guinea).

Coelonotus liaspis (not of Bleeker) Fowler, 1931: 323, fig. 24 (misident., Raiatea, Society Is.).

Coelonotus argulus argulus. Mauge, 1978: 98 (n. comb., characters in key, Comoro Is.).

Coelonotus argulus biocellatus. Mauge, 1978: 98 (n. comb., characters, Indonesia).

Diagnosis.—Trunk rings modally 16 (in 97%), snout depth averages 2.9 in snout length, adults typically with dark spots on pectoral-fin base and lateral scutella of trunk.

Table 3. Frequency distributions of tail rings in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Tail Rings																		
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
<i>Coelonotus</i>																			
<i>argulus</i>																8	22	4	2
<i>leiaspis</i>										1	18	42	13	1					
<i>Belonichthys</i>																			
<i>fluviatilis</i>	2	29	15																
<i>mento</i>			1	4	4	1													
<i>spinachioides</i>						3	2												
<i>Microphis</i>																			
<i>deocata</i>									1		3	2							
<i>dunckeri</i>						1	2	1											
<i>cruentus</i>										3	12	9	2						
<i>cuncalus</i>					3	15	22												
<i>Oostethus</i>																			
<i>manadensis</i>					10	8	4												
<i>pleurostictus</i>	1	2	5	5															
<i>insularis</i>										3	15	34	5						
<i>jagorii</i>			8	23	30	13													
<i>Lophocampus</i>																			
<i>retzii</i>							11	44	39	11	13								
<i>ocellatus</i>							1	4	2	2	1	1							
<i>brevidorsalis</i>						3	2	14	4										
<i>caudocarinatus</i>							1												

Description.—Rings 16–17 + 36–39, dorsal-fin rays 42–59, pectoral-fin rays 15–18, subdorsal rings 4.25–3.5 + 7.5–9.25 = 10.5–13.0 (see Tables 2–9 for additional counts). Proportional data, based on 27 specimens 61.0–132.0 ($\bar{x}$ = 97.3) mm SL, follow: HL in SL 8.5–11.7 (9.7), snout length in HL 2.3–2.7 (2.4), snout depth in snout length 2.5–3.4 (2.9), length of dorsal-fin base in HL 0.5–0.6 (0.5), anal ring depth in HL 3.4–4.8 (4.1), pectoral-fin length in HL 3.2–4.6 (4.1). Larger fish (>95–100 mm SL) typically with keeled scutella and supplemental ridge between superior trunk ridge and anterior portion of lateral tail ridge (Fig. 2); often with one or more keeled scutella on dorsum of trunk or tail; trunk not exceptionally deep in adult females.

Adults with prominent brown spots on pectoral-fin base and underneath pectoral fin, with ocellate dark spots on upper and lower lateral scutella of most or all trunk rings, spots sometimes continue on lateral scutella of several anterior tail rings. Smaller specimens (<ca. 90 mm SL) without distinctive markings.

Comparisons.—*Microphis argulus* differs from *M. leiaspis* in usually having fewer trunk rings (modally, 16 versus 17), in having more tail rings (36–39 versus 31–34), in its lower average snout depth in snout length ratio (2.9 versus 4.2), and in having supplemental body ridges and some keeled scutella (both absent in *M. leiaspis*). Additionally, adults of *M. argulus* typically have dark spots on the pectoral-fin base and ocelli on side of trunk. Such pigmentation is lacking in *M. leiaspis*. See key and diagnoses for other comparisons.

Types.—Peters (1852) described this species from two specimens. I have examined one of the syntypes (ZMB 6232) an adult female (107.5 mm SL) with 16 + 37

Table 4. Frequency distributions of total rings in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Total Rings																
	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
<i>Coelonotus</i>																	
<i>argulus</i>														7	23	4	2
<i>leiaspis</i>								1	1	17	43	12	1				
<i>Belonichthys</i>																	
<i>fluviatilis</i>		2	29	15													
<i>mento</i>				1	8	1											
<i>spinachioides</i>				3	2												
<i>Microphis</i>																	
<i>deocata</i>						1			3	2							
<i>dunckeri</i>				1	2	1											
<i>cruentus</i>									4	10	10	2					
<i>cuncalus</i>			4	9	24	8											
<i>Oostethus</i>																	
<i>manadensis</i>							11	8	3								
<i>pleurostictus</i>	2	3	4	4													
<i>insularis</i>											2	16	29	10			
<i>jagorii</i>			1	8	6	24	23	12									
<i>Lophocampus</i>																	
<i>retzii</i>					11	47	37	11	12								
<i>ocellatus</i>					1	4	2	1	2	1							
<i>brevidorsalis</i>			2	1	2	14	4										
<i>caudocarinatus</i>									1								

rings, 42 dorsal-fin rays, 16 rays in each pectoral fin and $2.5 + 7.75$ subdorsal rings. Keeled scutella and supplemental ridges are present above the subdorsal part of the lateral tail ridge and traces of a dark spot persist on the inferior left lateral scutellum between the 1st–2nd trunk rings.

Duméril (1870) described *Syngnathus platyrhynchus* from a single, presumably female, specimen (108 mm TL). This fish was not included in the type-list of Bertin and Estéve (1950), and it has not been located in subsequent searches of the Paris collection.

The holotype of *Coelonotus biocellatus* (BMNH 1868.11.17.37) was described as having $17 + 39$ rings and 48 dorsal-fin rays. I find this female specimen (now ca. 127 mm TL) to have $16 + 38$ rings, 54 dorsal-fin rays, and persistent dark spots on pectoral-fin base and side of trunk. In addition, there are keeled scutella and a supplemental ridge above the subdorsal part of the lateral tail ridge, and there are additional keeled scutella on dorsum of trunk and tail.

See this section under *Microphis leiaspis* for comment on presumptive type material of Kaup's (1856) *Syngnathus micrognathus* and *S. compressus*.

Remarks.—Among examined material, the smallest male with evidence of a brood pouch is 90 mm SL, the smallest brooding male is 97 mm SL, and brood-pouch eggs are in 2–4 transverse rows. One male (107 mm SL) has a total of ca. 112 pouch eggs deposited in 4 transverse rows.

Fowler (1932b) noted that the snout was depressed in four fish, whereas it was compressed laterally in 9 others examined from the Marquesas Is. The depressed and somewhat broadened snout, considered a distinguishing feature of *Syngnathus*

Table 5. Frequency distributions of dorsal-fin rays in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Dorsal-fin Rays															
	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69
<i>Coelonotus</i>																
<i>argulus</i>							1	5	20	4	2		1			
<i>leiaspis</i>											14	43	18	3		
<i>Belonichthys</i>																
<i>fluviatilis</i>													10	22	14	1
<i>mento</i>														1	4	6
<i>spinachioides</i>												1	2	2		3
<i>Microphis</i>																
<i>deocata</i>					6											
<i>dunckeri</i>		1	4													
<i>cruentus</i>			1	17	9											
<i>cuncalus</i>									7	18	9	1				
<i>Oostethus</i>																
<i>manadensis</i>				2	8	7	1									
<i>pleurostictus</i>		1	7	3	2											
<i>insularis</i>				22	34	1										
<i>jagorii</i>				12	55	15										
<i>Lophocampus</i>																
<i>retzii</i>				11	26	48	3									
<i>ocellatus</i>					2	9	1									
<i>brevadorsalis</i>	2	15	2													
<i>caudocarinatus</i>							1									

platyrhynchus by Duméril (1870), is variously present or absent in material examined here, and appears to be an artifact of preservation.

Study materials do not indicate significant geographic variation in frequencies of rings or pectoral-fin rays, but considerable variation occurs in frequencies of dorsal-fin rays. Indian Ocean material has 42–49 dorsal-fin rays, the count is 44–45 in two fish from the Louisiade Archipelago, and 46–52 in all others, except for the holotype of *Coelonotus biocellatus* and two specimens from Java (RMNH 29214) wherein the range is 54–59. High values of these three fish may reflect local population differences associated with reduced water temperature of mountain streams. In other material, frequencies of dorsal-fin rays seem to replicate the west to east clinal variation previously indicated for other pipefishes (Dawson, 1977; 1978). I find no evidence to support Mauge's (1978) proposal of Indian Ocean and western Pacific subspecies based on differences in frequencies of dorsal-fin rays.

Distribution.—Comoro Is., Mauritius and from Java eastward to the Marquesas Is. (Fig. 7). According to Mauge (1978), literature records from Madagascar have not been substantiated by recent collections, and I have been unable to locate museum material from this island. Among present material, one lot was taken with nightlight and dipnet, and at least 7 are from freshwater streams or rivers. The specimen from Fiji was taken among vegetation in a clear, fast flowing, stream. Most of the known specimens (57%) are from the Marquesas Is., but this may reflect success of collectors rather than increased local abundance.

Material Examined.—Thirty-seven specimens, 61–132 mm SL, including one syntype.

Table 6. Frequency distributions of pectoral-fin rays in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Pectoral-fin Rays							
	15	16	17	18	19	20	21	22
<i>Coelonotus</i>								
<i>argulus</i>	6	46	14	1				
<i>leiaspis</i>		2	40	76	24	1		
<i>Belonichthys</i>								
<i>fluviatilis</i>	1	7	29	16	5	1		
<i>mento</i>			3	2	16	4		
<i>spinachiodes</i>					7	3		
<i>Microphis</i>								
<i>deocata</i>					2	2	8	2
<i>dunckeri</i>				2	6	2		
<i>cruentus</i>				16	32	5		
<i>cuncalus</i>		6	38	32	3			
<i>Oostethus</i>								
<i>manadensis</i>				3	9	19	2	
<i>pleurostictus</i>				11	10	3	2	
<i>insularis</i>			1	7	14			
<i>jagorii</i>				8	28	52	23	2
<i>Lophocampus</i>								
<i>retzii</i>		5	43	64	16	1		
<i>ocellatus</i>			8	10	4			
<i>brevadorsalis</i>			2	4	19	10	3	
<i>caudocarinatus</i>				1	1			

Syntype.—ZMB 6232 (adult female, 107.5), Anjoan I. (Comoro Is.), Peters.

Other Material.—MAURITIUS: MCZ 6172 (2, 90–107.5). INDONESIA, Java: RMNH 29214 (2, 116–118.5). Flores: BMNH 1897.6.21 (1, 132). BISMARCK ARCH., New Britain: BMNH 1913.5.24.2 (1, 61). LOUISADE ARCH.: KFRS F.032070 (2, 83–91.5). SOLOMON IS., Guadalcanal: CAS 5893 (1, 66). FIJI IS., Taveuni: USP uncat. (1, 113). SAMOA IS., Upolu: BMNH 1926.3.6.51 (1, 97). SOCIETY IS., Raiatea: BPBM 5271 (1, 93.5). Loc. unknown: MCZ 36565 (1, 90). MARQUESAS IS., Nuka Hiva: CAS 48644 (3, 85.5–90). Uapou: BPBM 5292 (3, 93–98.5). Ua Huka: BPBM 10474 (2, 103.5–111), GCRL 20451 (2, 108–111). Hiva Oa: BMNH 1926.7.12.4 (1, 107), BPBM 12124 (3, 92–96), CAS-SU 24496 (4, 97–105), GCRL 20452 (1, 101.5). Fatu Hiva: BPBM 5291 (3, 99.5–108.5*). LOC. UNKNOWN: BMNH 1868.11.17.37 (120, female, holotype of *Coelonotus biocellatus*), Jeude coll., purchased. MNHN 9229 (badly damaged), "Madagascar, rec'd from Musée de Réunion."

Microphis (Coelonotus) leiaspis (Bleeker)

Figures 6–8

Syngnathus leiaspis Bleeker, 1853a: 5, 12, 20 (orig. descr., Batavia); Bleeker, 1858a: 447 (compiled); Bleeker, 1859: 187 (compiled); Bleeker, 1860a: 72 (compiled).

Hemimarsupium Goudotii Kaup, 1853: 234 (nomen nudum).

Syngnathus budi Bleeker, 1856: 6, 29, 77 (orig. descr., Manado); Bleeker, 1858b: 5 (compiled); Bleeker, 1858–1859: 209 (compiled); Bleeker, 1859: 186 (compiled); Bleeker, 1860a: 72 (compiled); Duméril, 1870: 558, 572 (in key, descr. compiled); Günther, 1870: 176 (descr.); Hubrecht, 1879: 51 (listed); Weber, 1908: 228 (Klipong R., New Guinea); Duncker, 1915: 57 (= *Coelonotus leiaspis*).

? *Syngnathus micrognathus* Kaup, 1856: 27 (nomen nudum).

? *Syngnathus compressus* Kaup, 1856: 27 (nomen nudum).

Hemithylacum Goudoti Kaup, 1856: 27 (nomen nudum).

Hemithylacum leiaspis. Kaup, 1856: 61 (n. comb., descr., Java and Madagascar); Duméril, 1870:

Table 7. Frequency distributions of subdorsal trunk rings in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Subdorsal Trunk Rings																	
	12.0	11.25	10.5	9.75	9.0	8.25	7.5	6.75	6.0	5.25	4.5	3.75	3.0	2.25	1.5	0.75	0.0	
<i>Coelonotus</i>																		
<i>argulus</i>											1	3	29	3				
<i>leiaspis</i>											9	70	2	1				
<i>Belonichthys</i>																		
<i>fluviatilis</i>	3	37	11	1														
<i>mento</i>	9	6																
<i>spinachioides</i>									1	4								
<i>Microphis</i>																		
<i>deocata</i>														4	3			
<i>dunckeri</i>														2	4			
<i>cruentus</i>															5	21	2	
<i>cuncalus</i>												3	39	6				
<i>Oostethus</i>																		
<i>manadensis</i>													11	10				
<i>pleurostictus</i>														7	6			
<i>insularis</i>															14	51		
<i>jagorii</i>													27	55	4			
<i>Lophocampus</i>																		
<i>retzii</i>															17	105	4	
<i>ocellatus</i>															3	9	1	
<i>brevadorsalis</i>															16	8		
<i>caudocarinatus</i>														1				

572, 599 (in key, =*Syngnathus leiaspis*); Sauvage, 1891: 507, 528, pl. 50, fig. 5 (synon., descr., Madagascar).

Hemimarsupium Goudoti. Bleeker, 1858a: 448 (emendation, compiled); Bleeker, 1859: 188 (compiled).

Syngnathus ? budi. Bleeker, 1860b: 13 (in sea and rivers, Manado and Tanawanko).

Coelonotus liaspis. Günther, 1870: 188 (n. comb., emendation, synon., descr.); Bleeker, 1874: 75 (compiled); Boulenger, 1915: 84, fig. 71 (in key, descr., range); Duncker, 1915: 57 (synon., descr., freshwater, range); Weber and de Beaufort, 1922: 57, fig. 24 (synon., descr., fresh and brackish waters, range); Fowler, 1928: 111 (synon. in part, characters, range); Pellegrin, 1933: 188, fig. 102 (in key, synon., descr., Madagascar); Fowler, 1938: 274 (compiled); Matsubara, 1955: 425 (characters in key); Munro, 1958a: 143 (compiled); Arnoult, 1959: 36 (synon., descr., rivers in slow current, Madagascar); Fehlmann, 1960: 67, 92, pl. 20, fig. b (freshwater, Palau Is.); Munro, 1967: 153 (characters in key); Shiino, 1972: 61 (compiled); Randall, 1973: 182 (note); Kählsbauer, 1974: 278 (characters, Papua New Guinea); Masuda et al., 1975: 183, pl. 25, fig. a (characters, range); Lee, 1983: 72 (Taiwan).

Coelonotus leiaspis. Hubrecht, 1879: 51 (listed); Jordan and Richardson, 1908: 246 (notes; Mindoro and Sibuyan Is., Philippine Is.); Jordan and Richardson, 1910: 17 (compiled); de Beaufort, 1913: 103, fig. 3 (synon., coloration, rivers; Buru and Waigeu, Indonesia); Seale, 1935: 354 (Guadalcanal and Suva, Fiji Is.); Roxas and Martin, 1937: 77 (compiled); Fowler, 1949: 65 (compiled); Herre, 1953: 205 (synon., refs., range); Koumans, 1953: 204 (notes, Manado); Herre, 1958: 72 (compiled); Fowler, 1959: 134, fig. 67 (descr., range, Fiji); Smith, 1963: 528, pl. 77, fig. G (synon., descr., rivers and estuaries, range); Mauge, 1978: 98 (in key, range); Ryan, 1980: 61 (Waimanu R., Fiji Is.); Dawson and Fourmanoir, 1981: 118 (freshwater, New Caledonia).

Coelonotus Vaillantii Juillerat, 1880: 176 (orig. descr., Madagascar).

Coelonotus vaillanti. Sauvage, 1891: 508, 528, pl. 49, fig. 6 (emendation, descr.); Duncker, 1915: 57 (= *C. liaspis*); Bertin and Estève, 1950: 44 (compiled).

Siphostoma yoshi Snyder, 1909: 597 (orig. descr.; Tanegashima, Japan); Duncker, 1915: 57 (provisionally to synon. of *Coelonotus liaspis*).

Table 8. Frequency distributions of subdorsal tail rings in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Subdorsal Tail Rings									
	3.0	3.75	4.5	5.25	6.0	6.75	7.5	8.25	9.0	9.75
<i>Coelonotus</i>										
<i>argulus</i>							4	25	7	
<i>leiaspis</i>							5	56	20	1
<i>Belonichthys</i>										
<i>fluviatilis</i>	7	35	10							
<i>mento</i>	2	8	5							
<i>spinachioides</i>				1	1	3				
<i>Microphis</i>										
<i>deocata</i>				4	3					
<i>dunckeri</i>			3	3						
<i>cruentus</i>					12	15	1			
<i>cuncalus</i>					8	30	10			
<i>Oostethus</i>										
<i>manadensis</i>					6	14	1			
<i>pleurostictus</i>			2	11						
<i>insularis</i>				1	21	42	1			
<i>jagorii</i>			3	36	40	7				
<i>Lophocampus</i>										
<i>retzii</i>						37	54	34	1	
<i>ocellatus</i>						2	9	2		
<i>brevidorsalis</i>		2	10	10	2					
<i>caudocarinatus</i>							1			

Syngnathus yoshi. Snyder, 1912: 407, pl. 51, fig. 3 (n. comb., ref. only); Jordan et al., 1913: 95 (compiled); Okada, 1938: 158 (compiled).

Coelonotus liapsis (sic). Chabanaud, 1929: 169 (descr., Amboine).

Cölonotus (sic) *liaspis*. Kähnsbauer, 1970: 152 (descr., range, Port Moresby).

Diagnosis.—Trunk rings modally 17 (in 95%), snout depth averages 4.2 in snout length, without dark spots on pectoral-fin base and lateral scutella of trunk.

Description.—Rings 16–18 + 30–34, dorsal-fin rays 53–63, pectoral-fin rays 16–20, subdorsal rings 4.5–2.5 + 7.5–9.5 = 10.75–13.0 (see Tables 2–9 for additional counts). Proportional data, based on 25 specimens 83.5–159.5 ($\bar{x}$ = 120.0) mm SL, follow: HL in SL 8.1–10.7 (9.4), snout length in HL 2.2–2.6 (2.4), snout depth in snout length 3.6–4.9 (4.2), length of dorsal-fin base in HL 0.4–0.6 (0.5), anal ring depth in HL 3.1–5.2 (4.0), pectoral-fin length in HL 3.6–6.2 (4.4). Without supplemental ridge or keeled scutella above anterior part of lateral tail ridge; trunk depth of adult females somewhat greater than that of adult males (averages 2.3 in HL versus 3.3 in adult males).

Mainly plain without distinctive markings, usually darkest on upper part of side of trunk, scutella sometimes margined with dark brown.

Comparisons.—See key, diagnoses and this section under *Microphis argulus*.

Types.—Bleeker's (1853a) description was based on two, apparently female, specimens (142 and 147 mm TL), but Hubrecht (1879) listed only one specimen in the Auction Catalogue and noted that it was in poor condition. This female fish (RMNH 7252), apparently the only extant syntype, now lacks most of the snout,

Table 9. Frequency distributions of total subdorsal rings in subgenera and species of *Microphis* (See Dawson, 1979, for data on *M. brachyurus* ssp.)

Subgenus Species	Total Subdorsal Rings															
	5.25	6.0	6.75	7.5	8.25	9.0	9.75	10.5	11.25	12.0	12.75	13.5	14.25	15.0	15.75	16.5
<i>Coelonotus</i>																
<i>argulus</i>								6	21	8	1					
<i>leiaspis</i>								1	3	42	36					
<i>Belonichthys</i>																
<i>fluviatilis</i>													18	30	4	
<i>mento</i>														5	8	2
<i>spinachioides</i>									2	2	1					
<i>Microphis</i>																
<i>deocata</i>				1	5	1										
<i>dunckeri</i>			2	4												
<i>cruentus</i>				6	20	2										
<i>cuncalus</i>						2	16	29	1							
<i>Oostethus</i>																
<i>manadensis</i>						1	12	7	1							
<i>pleurostictus</i>			1	8	4											
<i>insularis</i>				5	54	6										
<i>jagorii</i>				1	23	44	18									
<i>Lophocampus</i>																
<i>retzii</i>					16	78	30	2								
<i>ocellatus</i>					3	7	3									
<i>brevadorsalis</i>	3	13	8													
<i>caudocarinatus</i>							1									

pectoral and dorsal fins, and part of the tail. The opercle lacks a longitudinal ridge, there are 17 trunk rings, 4 + 7.75 subdorsal rings and 4 anal-fin rays. Some ink-marks persist and the specimen was probably the model for the illustration of *Coelonotus leiaspis* (Pl. 451, fig. 13) in Bleeker's unpublished Atlas.

Kaup (1853) introduced the name *Hemimarsupium* for a genus represented by *H. Goudotii* and its junior synonyms, *Typhlus Goudotii* Bibron MS, *Syngnathus micrognathus* Kuhl and van Hasselt MS and *S. compressus* Kuhl and van Hasselt MS. All of these names were nomina nuda.

Subsequently, Kaup (1856, p. 27) stated that three Leiden specimens of *S. micrognathus* were conspecific with *S. compressus* and that these names were synonymous with *Typhlus Goudoti*. He further remarked, "This latter (name) I prefer for the species designation. Vide *Hemithylacum Goudoti*." Later (p. 61), Kaup diagnosed the genus *Hemithylacus* with *Syngnathus leiaspis* Bleeker as the type-species, and listed *Typhlus Goudoti*, *Syngnathus micropterus* (a lapsus calami) and *S. compressus* as junior synonyms thereof. However, Kaup included *Hemithylacus Goudotii* in his species list (p. 76) but omitted *H. leiaspis* therefrom. It would appear that Bleeker's (1853a) description of *Syngnathus leiaspis* forced Kaup to emend his planned description of the species as *Hemithylacus Goudotii*, and that he failed to fully correct his manuscript.

Kaup (1856) indicated that there were then four specimens (a male and three females) from Java in the Leiden collection, and four female specimens, collected from Madagascar by M. Goudot, in the Paris collection. The Rijksmuseum now has four specimens of *Microphis* obtained from Java by Kuhl and van Hasselt,

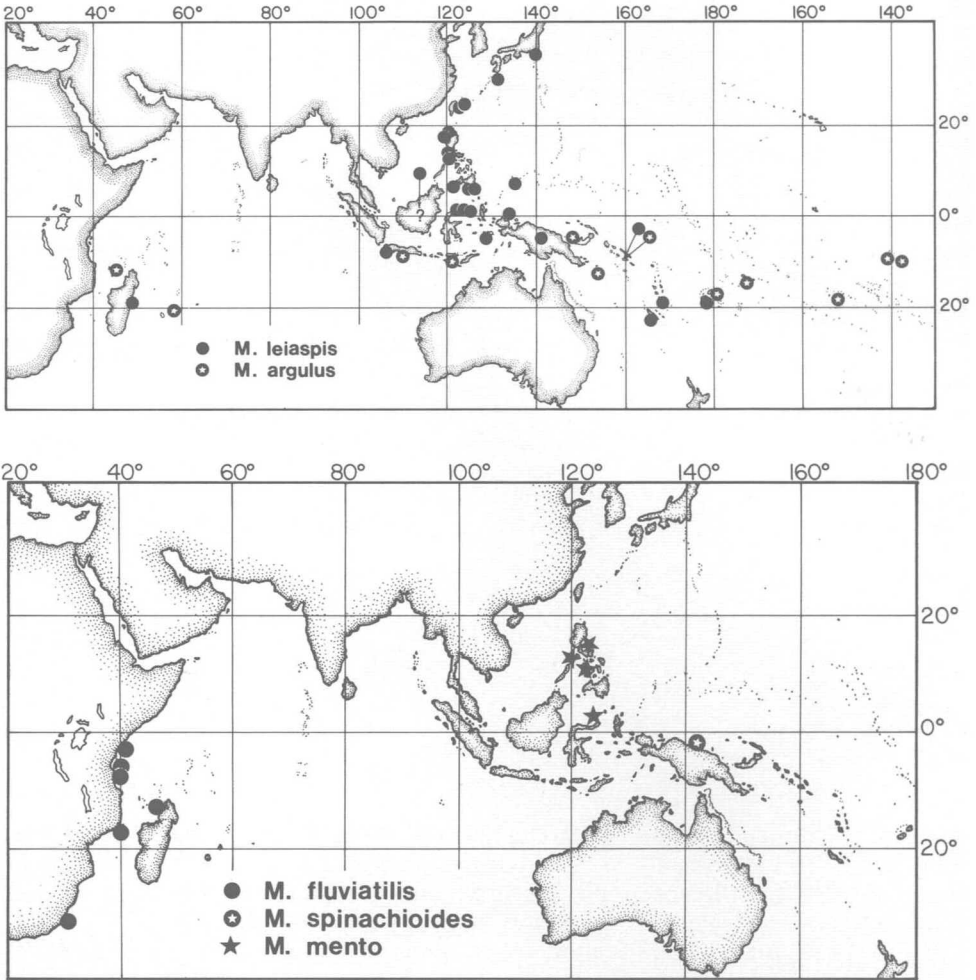


Figure 7. Distributions of species of the subgenera *Coelonotus* (top) and *Belonichthys* (bottom) based on material examined.

and I have examined three specimens of *Microphis leiaspis* (122–146.5 mm SL) in the Muséum Histoire Naturelle collected by Goudot (MNHN A.1436 and 6033). The Rijksmuseum material includes an adult male and an adult female of *M. leiaspis* (RMNH 3855) and two females or immature males of *M. argulus* (RMNH 29214). The former are apparently the two fish noted by Kaup (1856) as having total lengths of 6.32 and 7.29 inches (160.5 and 185 mm). The female specimen now lacks the distal part of the tail and has a residual overall length of 174 mm, whereas the male (now 165 mm SL) has a regenerated tail and only 6 caudal-fin rays.

Despite the fact that two MS names (*micrognathus*, *compressus*) had been proposed for these Kuhl and van Hasselt specimens, Kaup apparently failed to examine the two smaller specimens (116–118.5 mm SL) carefully, and thereby failed to note that the material from Java included two species. There is no

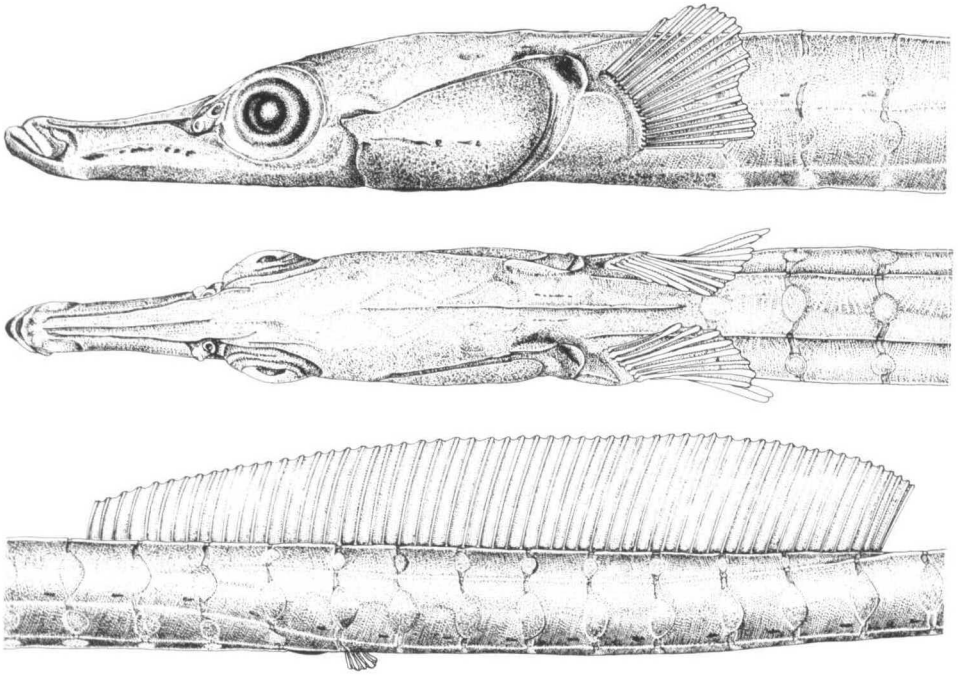


Figure 8. *Microphis leiaspis*. Lateral and dorsal aspects of head and anterior trunk rings, together with section of body illustrating ridge configuration and dorsal and anal fins. From 107 mm SL female or immature male (GCRL 16948).

evidence concerning which of the Kuhl and van Hasselt names was originally applied to *M. leiaspis*, but the rather deep and somewhat compressed trunk of the adult female could well suggest the name “*compressus*.”

The description of *Syngnathus budi* Bleeker (1856) was based on 7 presumably juvenile specimens (96–104 mm TL), and Hubrecht (1879) listed 10 specimens in the Auction Catalogue (A series). Three Bleeker specimens examined here (RMNH 7238) fall within the length range of the original material and are considered to be presumptive syntypes. Günther (1870) and Duncker (1915) mention their examination of single Bleeker specimens of both *S. leiaspis* and *S. budi* in the British Museum collection, but it appears that only one fish (BMNH 1867.11.28.349) was available for study. This specimen, now lacking part of the tail, was described by Duncker (1915) as having a regenerated tail, 17 + 25 rings, ca. 7 caudal-fin rays and a total length of 142 mm. This fish is not here considered a syntype of either Bleeker species, since it is larger than any original specimen of *S. budi* and Duncker's meristic data do not agree with Bleeker's original counts for *S. leiaspis*.

The holotypes of *Coelonotus vaillantii* (MNHN A.2359) and *Siphostoma yoshi* (USNM 62944) are conspecific with *Microphis leiaspis*.

Remarks.—Among material examined, the smallest male with brood pouch is 105.5 mm SL, the smallest brooding male is 112.5 mm SL, and brood-pouch eggs are in 4–6 transverse rows. Pouch eggs are largely lost in present material, but one fish (149.5 mm SL) has ca. 200 eggs and/or membranous egg-compartments in the pouch.

Tail rings are 32–34 and pectoral-fin rays are 16–19 in specimens from Madagascar, whereas these values are 31–33 and 17–20 in other material. I find no evidence of geographic variation in material examined.

Distribution.—Madagascar, Indonesia to Japan (Honshu I.), and southeastward to New Caledonia and Fiji (Fig. 7). Although records from Madagascar are accepted here, it is noteworthy that there are apparently no museum specimens of this species obtained from Madagascar subsequent to ca. 1885–1890. There are few useful data on collection methods or habitats, but 11 samples are from rivers or streams and at least two lots were taken with nightlight and dipnet. One specimen (USP uncat.) is accompanied by notes stating that the fish appeared to live under stones in a quiet pool of a clear, fast flowing, stream. Fehlmann (1960) recorded *M. leiaspis* from a sluggish freshwater stream in the Palau Is.

Material Examined.—Eighty-eight specimens, 80–180 mm SL, including one syntype.

Syntype.—RMNH 7252 (female, 109*), Batavia, P. Bleeker.

Other Material.—MADAGASCAR: BMNH 1889.8.1.33 (2, 136–136.5), MNHN 32-22 (1, 105.5), MNHN 32-23 (1, 117), MNHN A.1436 (1, 146.5), MNHN A.2359 (male, 121, holotype of *C. vaillantii*), MNHN 6033 (2, 122–137), ZMB 13468 (2, 112.5–127), ZMB 19775 (2, 115.5–133). INDONESIA, Java: RMNH 3853 (1, 94.5), RMNH 3855 (2, 165–180), RMNH 28739 (14, 80–112). Borneo (loc. unknown): RMNH 3854 (1, 90*). Celebes: BMNH 1867.11.28.349 (1, 131*), CAS 48642 (12, 82.5*–94), CAS-SU 29002 (4, 92–93), RMNH 7238 (3, 87*–95*, presumptive syntypes of *Syngnathus budi*), USNM 150976 (1, 87). Ambon: MNHN 1969-31 (1, 128.5). Irian Jaya: ZMUC P.39574 (1, 81). TAIWAN: YCM P.1732 (1, 92). PHILIPPINE IS., Luzon: CAS 32935 (1, 116), CAS-SU 29809 (1, 148), GCRL 16948 (1, 107), USNM 133173 (1, 83.5). Mindoro: CAS-SU 20458 (1, 157), USNM 137288 (1, 90.5), USNM 137290 (1, 92), USNM 137291 (1, 93). Catanduanes: GCRL 17470 (3, 149.5–159.5). Mindanao: CAS 48641 (2, 92.5–93), USNM 133171 (1, 95.5), USNM 133594 (2, 91–100), USNM 137289 (2, 90–95). Limbe Str.: USNM 137286 (1, 94). JAPAN, Ryukyu Is.: IORD uncat. (1, 95), YCM uncat. (1, 146.5). Tanegashima: USNM 62944 (female, 100.5, holotype of *Siphonostoma yoshi*). Honshu: YCM P.7262 (1, 112.5). PALAU IS.: CAS 48639 (2, 146.5–151.5). PAPUA NEW GUINEA, Kiunaja: KFRS F.4824.01 (1, 150.5). SOLOMON IS., Guadalcanal: USP uncat. (1, 86.5). NEW HEBRIDES IS., Efate: AMS IA.779 (4, 90–95). NEW CALEDONIA: CAS 43966 (1, 159). FIJI IS., Viti Levu: CAS 5894 (1, 83.5).

Subgenus *Belonichthys* Peters

Belonichthys Peters, 1868: 108 (type-species, *Syngnathus zambezensis* Peters, 1855a [= *S. fluviatilis* Peters, 1852], by monotypy).

Parabelonichthys Fowler, 1943: 57 (type-species, *Parabelonichthys kellersi* Fowler, 1943, by original designation).

Diagnosis.—Longitudinal opercular ridge present; without supplemental opercular ridges; principal body ridges distinct; with or without keeled scutella; with supplemental body ridges; with or without distinct ridges on pectoral-fin base, fin rounded to emarginate; pouch plates slightly to strongly convergent in brooding males, free margins overlapping some or most of brood-pouch eggs; brood-pouch eggs in 2–6 or more transverse rows; snout depth 2.2–4.9 in snout length; tail rings 21–27; total subdorsal rings 11.0–16.75.

Comparisons.—See characters in key, diagnoses, and discussion of subgenera.

Remarks.—The longitudinal opercular ridge is not strongly elevated above the surface of the operculum, but it is complete and reasonably distinct in most examined adults. Opercular striae are often distinct in large specimens but they are not sufficiently well defined to be considered as supplemental ridges. Supplemental body ridges and keeled scutella are present in examined adults of *M. fluviatilis* and *M. mento*, but keeled scutella are lacking in the only available adult of *M. spinachioides*. The latter specimen, a brooding male, has much more strongly

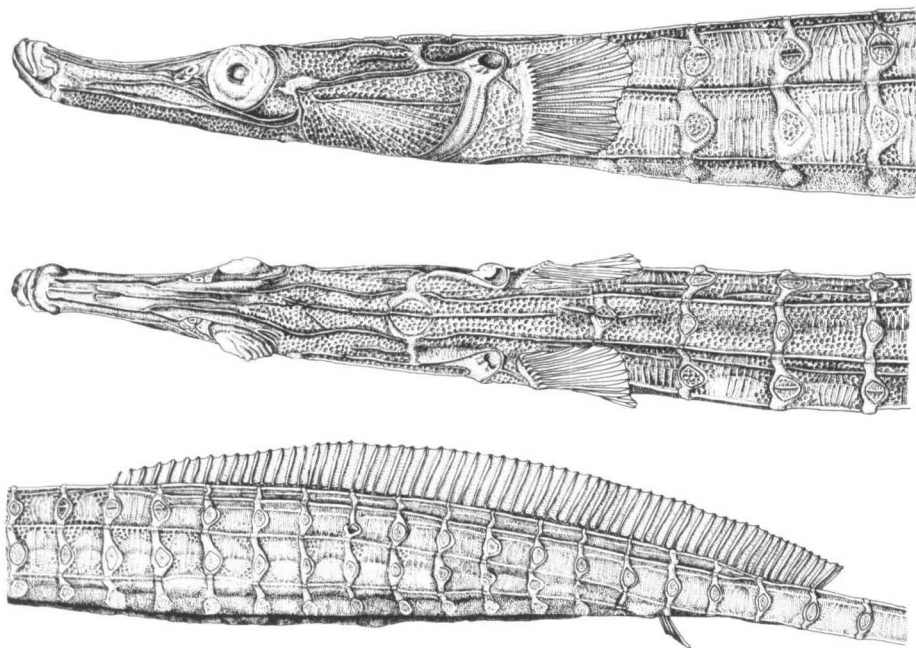


Figure 9. *Microphis fluviatilis*. Lateral and dorsal aspects of head and anterior trunk rings, together with section of body illustrating ridge configuration and dorsal and anal fins. Note keeled scutella and supplemental ridges on anterior trunk rings. From 187.5 mm SL female (GCRL 17312).

convergent pouch plates than those of comparable examples of *M. fluviatilis*. Nevertheless, *M. spinachioides* is provisionally referred to the subgenus *Belonichthys* due to agreement in general physiognomy, frequencies of total rings, and relatively high frequencies of dorsal-fin rays, subdorsal trunk rings, and total subdorsal rings.

Duncker (1912, 1915) diagnosed *Belonichthys* as having smooth, weakly developed, body ridges, and stated that the pouch plates were convergent, probably united by a distal (marginal) membrane, and that the eggs were covered (enclosed) by the pouch plates. Duncker evidently examined few adults of the type-species (*Microphis fluviatilis*) and was apparently unaware that body ridges are distinct in large specimens (>ca. 175 mm SL), that pouch plates are neither strongly convergent nor united by a membrane, and do not enclose the brood-pouch eggs.

Microphis (Belonichthys) fluviatilis (Peters)

Figures 9 and 10

Syngnathus fluviatilis Peters, 1852: 685 (orig. descr.; Tette [Tete], Mozambique).

Syngnathus Zambezensis Peters, 1855a: 278 (incorrectly proposed as replacement name for *S. fluviatilis* Peters, presumed to be preoccupied); Peters, 1855b: 465 (belongs in genus *Doryichthys* Kaup).

Belonichthys (Syngnathus) zambezensis. Peters, 1868: 109, pl. 20, figs. 5–5b (n. comb.; descr.; Molumbo and Zambezi rivers, Mozambique).

Syngnathus zambezensis. Peters, 1869a: 147 (emendation, type-species of *Belonichthys*).

Belonichthys zambezensis. Duméril, 1870: 587 (n. comb., descr., Zanzibar); Sauvage, 1879: 44 (ref.); Sauvage, 1891: 528 (listed); Jordan, 1919: 353 (listed).

Doryichthys mento. Günther, 1870: 181 (misident., in part; eastern Africa).

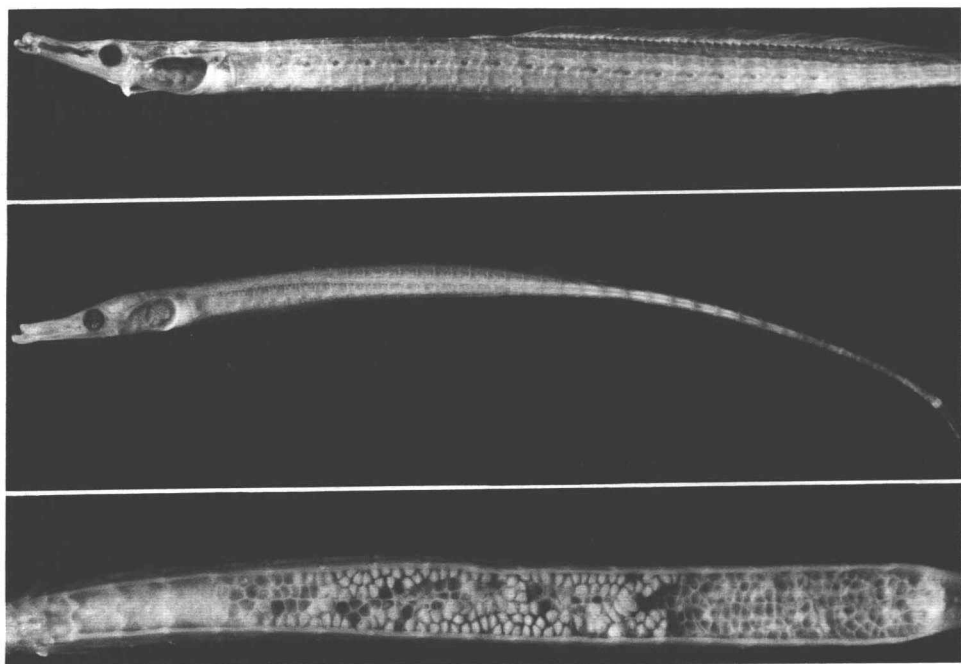


Figure 10. *Microphis fluviatilis* (Peters). Top: Adult female, 152 mm SL (NMC 81-193). Middle: Juvenile, 72 mm SL (GCRL 14895). Bottom: Ventral aspect of pouch of brooding male, 137.5 mm SL, illustrating eggs in situ and membranous egg-compartments (GCRL 17312).

Belonichthys Sancti Pauli Sauvage, 1879: 44, pl. 1, fig. 1 (orig. descr.; Saint Paul I.); Blanc, 1961: 137, 144, fig. 36 (descr. compiled).

Syngnathus (Belonichthys) zambezensis. Peters, 1881: 108 (n. comb., compared with *S. mento*).

Belonichthys fluviatilis. Duncker, 1912: 230 (type-species of *Belonichthys*); Duncker, 1915: 58 (in part, synonym., descr., eastern Africa and Madagascar); Weber and de Beaufort, 1922: 59 (in part, synonym., descr.); Barnard, 1925: 286 (in part, synonym. and refs.); Pellegrin, 1933: 187 (to be expected, Madagascar); Smith, 1949: 170, fig. 359 (characters, Mozambique); Bertin and Estève, 1950: 44 (incorrectly as sr. syn. of *Hemithylacus rocaberti*); Herre, 1953: 202 (synonym. and refs. in part); Smith, 1963: 528, pl. 80, figs. D-E (synonym. in part, characters, Kenya); Smith, 1975: 29 (compiled); Kählsbauer, 1976: 283 (characters; juveniles over depth of 3,485 m between Comoro Is. and Madagascar); Shiino, 1976: 107 (compiled); Smith, 1980: 175 (compiled).

Belonichthys zambezensis (sic). Boulenger, 1915: 82, fig. 68 (synonym., characters, range).

Belonichthys sanctipauli. Hureau, 1969: 1154 (emendation).

Diagnosis.—Snout relatively slender, its depth averages 4.0 in snout length; trunk rings modally 19; tail rings 21–23; subdorsal trunk rings 12.0–10.0.

Description.—Rings 18–20 + 21–23, dorsal-fin rays 60–69, pectoral-fin rays 15–20 (usually 17–18), subdorsal rings 12.0–10.0 + 3.0–4.5 = 14.0–15.75 (see Tables 2–9 for additional counts). Proportional data, based on 19 specimens 73–178.5 ($\bar{x}$ = 115.4) mm SL, follow: HL in SL 5.6–9.4 (7.3), snout length in HL 2.3–2.5 (2.4), snout depth in snout length 3.2–4.8 (4.0), length of dorsal-fin base in HL 0.4–0.6 (0.5), anal ring depth in HL 4.2–6.4 (5.5), pectoral-fin length in HL 3.7–5.5 (4.7). Large fish (>ca. 175 mm SL) with one or more supplemental ridges above lateral trunk ridge and with keeled scutella on upper part of side of trunk; without lateral supplemental ridge on distal third or more of tail.

Snout with a dark lateral stripe, lower half or more of opercle often iridescent silvery, sometimes with diffuse dark spots or ocelli on lateral trunk ridge.

Comparisons.—*Microphis fluviatilis* is distinguished from *M. spinachioides* by higher frequencies of trunk rings (18–20 versus 16) and subdorsal trunk rings (12.0–10.0 versus 6.0–5.5 in *M. spinachioides*). *Microphis fluviatilis* shares relatively high frequencies of trunk rings and subdorsal trunk rings with *M. mento*, but differs in having a higher average snout depth in snout length ratio (4.0 versus 2.9), in having somewhat fewer tail rings (21–23 versus 23–26), and in having a tendency toward fewer dorsal-fin rays (60–69 versus 62–74). Furthermore, adults of *M. fluviatilis* tend to have more supplemental body ridges and fewer keeled scutella than adults of *M. mento*.

Types.—Peters (1852) failed to mention the number of specimens included in his original description, but later (1868) noted that he had a female specimen from Mozambique, and a female and two males (122 and 140 mm TL) from the Zambezi River. I have examined the larger male of these presumptive syntypes (ZMB 6233), but I have been unable to locate the holotype of *Belonichthys sanctipauli* Sauvage.

Remarks.—The smallest examined male with developing pouch plates is 99.5 mm SL and the smallest brooding male is 137.5 mm SL. One male (140.5 mm SL) has eggs (ca. 0.7 mm max. diameter) deposited in a maximum of six transverse rows, there are approximately 82 eggs in the outer right row, and the slightly convergent pouch plates fall just short of concealing the two outer rows of eggs, bilaterally.

Present meristic data show no evidence of geographic variation.

Distribution.—Eastern Africa (Kenya to South Africa) and Madagascar (Fig. 7). Sauvage's (1879) description of the holotype of *Belonichthys sanctipauli* (97 mm TL) as being dredged within sight of St. Paul I. seems questionable. This fish may have been a stray captured fortuitously, but it represents the only offshore record of any subadult of the subgenus *Belonichthys* and specimens of *Microphis* are seldom taken in dredges. As noted by Hureau (1969), there are no subsequent records of this species from the St. Paul and Amsterdam Is. Most samples with adequate data are from rivers.

Material Examined.—Fifty-four specimens, 71–201 mm SL, including one presumptive syntype.

Presumptive Syntype.—ZMB 6233 (male, 135 mm SL), Zambezi River, Tete, Dec. 1844.

Other Material.—KENYA, Sabaki R.: RUSI 12288 (4, 132*–201). ZANZIBAR: MNHN 2407 (1, ca. 76). TANZANIA, Rufiji R.: NMC 81-193 (3, 99.5–152). SOUTH AFRICA, Mtata R.: GCRL 14895 (6, 73–82), RUSI 4651 (24, 71–82.5). Coffee Bay: AMS I.20466-001 (2, 77–81), AMS I.20470-001 (1, 75). MADAGASCAR, Rio Djabal: USNM 216257 (1, 96). LOC. UNCERTAIN, prob. Madagascar: GCRL 17312 (3, 137.5–187.5), MNHN uncat. (8, 140.5–178.5).

Microphis (Belonichthys) mento (Bleeker) Figures 11 and 12

Syngnathus mento Bleeker, 1856: 6, 29, 75 (orig. descr.; Manado [Celebes]); Duméril, 1870: 568, 571 (in key, descr. compiled); Peters, 1881: 108 (compared with *S. zambezensis*); Duncker, 1915: 58 (= *Belonichthys fluviatilis*).

Syngnathus? mento. Bleeker, 1859: 187 (compiled, Celebes); Bleeker, 1860a: 72 (compiled); Bleeker, 1860b: 13 (compiled).

Hemithylacus Rocaberti Duméril, 1870: 599 (in key, orig. descr., Manila); Duncker, 1915: 58 (= *Belonichthys fluviatilis*).

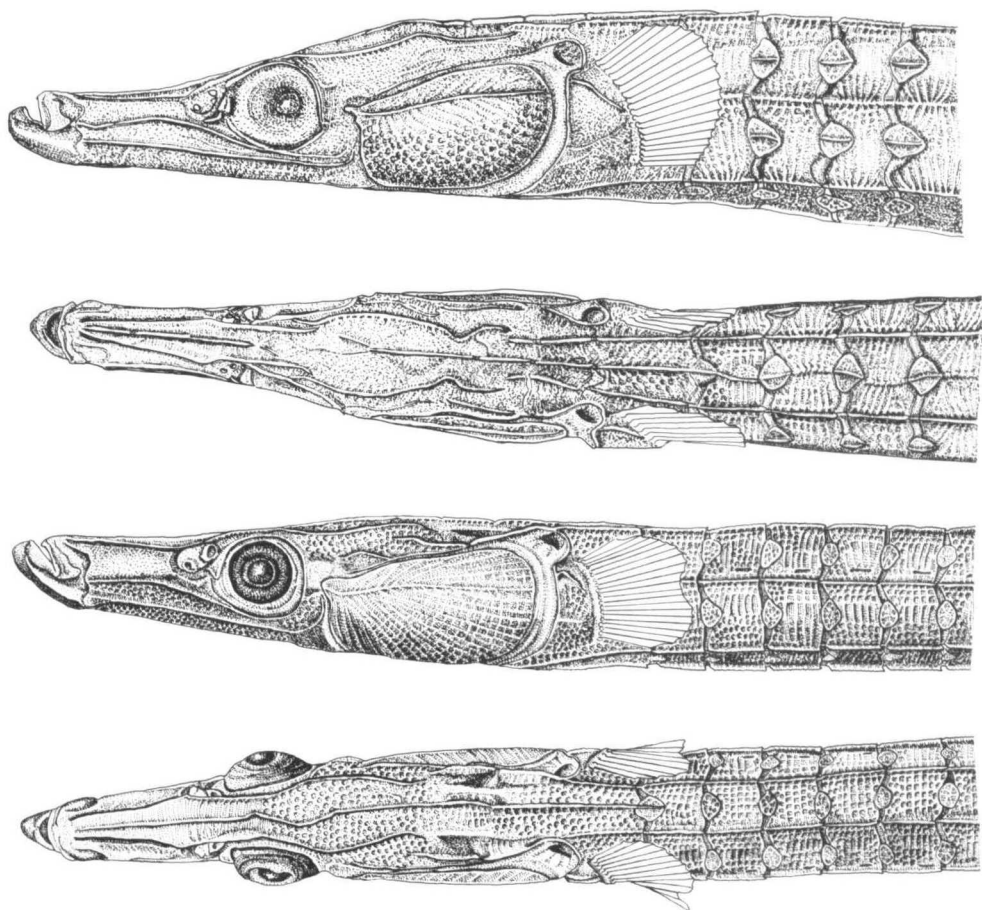


Figure 11. Lateral and dorsal aspects of head and anterior trunk rings. Upper pair: *Microphis mento*, from 104.5 mm SL female, syntype of *Hemithylacus rocaberti* (MNHN A.1701). Lower pair: *Microphis spinachoides*, from 75 mm SL juvenile (GCRL 19010).

Doryichthys mento. Günther, 1870: 181 (n. comb.; in part, synonym, Celebes); Hubrecht, 1879: 51 (listed); Károli, 1882: 186 (listed; Sadong, Borneo).

Doryrhamphus mento. de Beaufort, 1913: 102 (n. comb.; freshwater; Kajeli, Buru I.).

Belonichthys fluviatilis (not of Peters) Duncker, 1915: 58 (in part; Celebes, Philippine Is.); Weber and de Beaufort, 1922: 59, fig. 25 (synonym, in part; Celebes, Buru); Roxas and Martin, 1937: 77 (compiled); Herre, 1953: 202 (synonym, and refs., in part); Herre, 1958: 72 (compiled).

Parabelonichthys kellersi Fowler, 1943: 58, fig. 7 (orig. descr.; Jaro River, Iloilo, Panay I., Philippine Is.); Herre, 1953: 203 (= *Belonichthys fluviatilis*); Herald, 1953: 231 (= *B. fluviatilis*).

Hemithylacus rocaberti. Bertin and Estéve, 1950: 44 (emendation, syntypes listed).

Diagnosis.—Snout relatively deep, its depth averages 2.9 in snout length; trunk rings usually 18–19; tail rings 23–26; subdorsal trunk rings 12.0–11.0.

Description.—Rings 17–19 + 23–26, dorsal-fin rays 62–74, pectoral-fin rays 17–20 (usually 19), subdorsal rings 12.0–11.0 + 3.0–4.75 = 14.75–16.75 (see Tables 2–9 for additional counts). Proportional data, based on 10 specimens 63.5–116.0 ($\bar{x}$ = 95.6) mm SL, follow: HL in SL 5.4–8.2 (7.0), snout length in HL 2.4–2.8 (2.6), snout depth in snout length 2.2–3.2 (2.9), length of dorsal-fin base in HL 0.4–0.6 (0.5), anal ring depth in HL 3.3–4.9 (4.0), pectoral-fin length in HL 4.5–

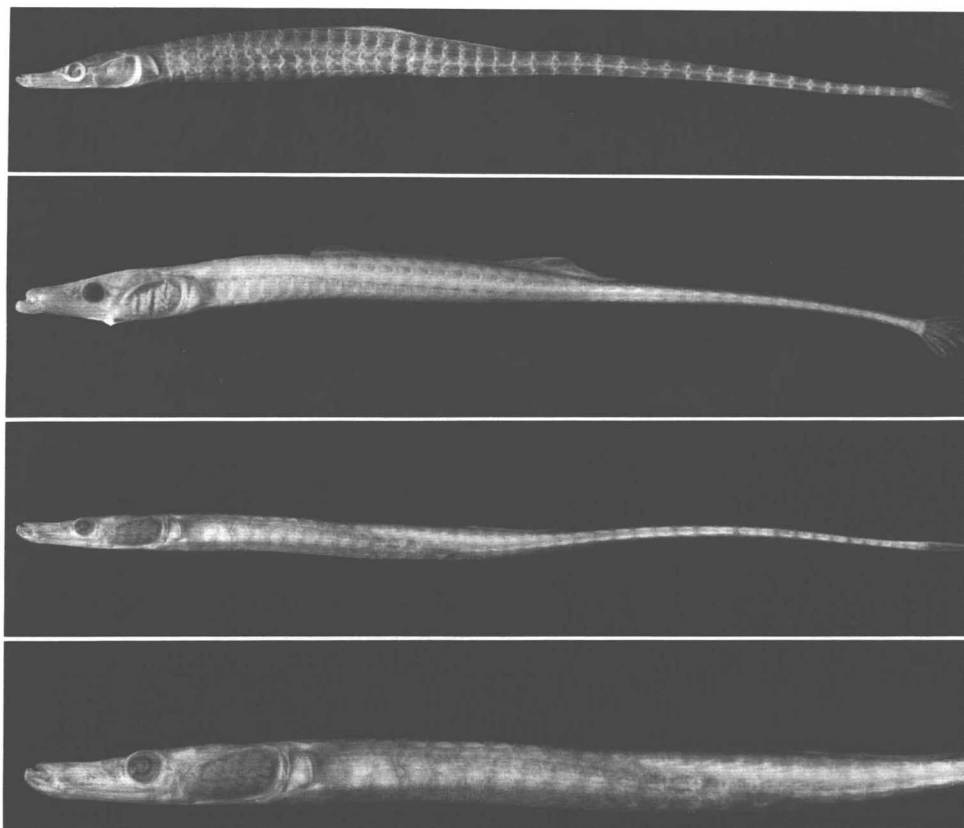


Figure 12. Upper pair: *Microphis mento* (Bleeker). Top.—Adult female, 104.5 mm SL (MNHN A.1701). Bottom.—Juvenile, 63.5 mm SL (CAS 48643). Lower pair: *M. spinachioides* (Duncker), juvenile, 75 mm SL (GCRL 19010).

5.1 (4.8). With keeled scutella on side and dorsum of trunk, sometimes also on side and dorsum of tail; usually with supplemental ridges on upper part of side of trunk, on dorsum before dorsal fin, on side of tail and sometimes on venter of tail.

Study material faded in preservative, without persistent markings.

Comparisons.—*Microphis mento* shares a relatively deep snout with *M. spinachioides*, but differs in having more trunk rings and subdorsal trunk rings (respectively, 17–19 and 12.0–11.0 versus 16 and 6.0–5.5) and in having keeled scutella (apparently absent in *M. spinachioides*). For additional comparisons, see this section under *M. fluviatilis*.

Types.—Bleeker's (1856) description of *Syngnathus mento* was based on two juveniles (64 and 71 mm TL), and two damaged specimens (BMNH 1867.11.28.351, RMNH 7243) are here considered to be presumptive syntypes. The latter fish is ink-marked and may be the model for the illustration of *Doryichthys mento* (Pl. 451, fig. 10) in Bleeker's unpublished Atlas.

Duméril (1870) gave counts of 18 + 25 rings and 64 dorsal-fin rays in his description of *Hemithylacus rocaberti*. I find one of the three syntypes (MNHN

A.1701) to have 19 + 24 rings and 62 dorsal-fin rays, whereas the others (MNHN 2085) have 18–19 + 25 rings and 67–68 dorsal-fin rays.

Fowler (1943) described *Parabelonichthys kellersi* from four fish and gave counts of 57 dorsal- and 15 pectoral-fin rays. The dorsal fin is now damaged in the holotype (USNM 108466) but there are 17 and 18 fin-rays in the pectoral fins. I count 18–20 pectoral-fin rays and 68, 69 and 73 dorsal-fin rays in the three paratypes (USNM 108468, 119443).

Remarks.—There are no brooding males in examined material and the only male with a brood pouch is 107.5 mm SL.

Duncker (1915) synonymized *Syngnathus mento* Bleeker and *Hemithylacus rocaberti* Duméril with *Belonichthys fluviatilis* Peters, and Herald (1953) synonymized *Parabelonichthys kellersi* with *Belonichthys fluviatilis*. I consider *Microphis mento* to be distinct from *M. fluviatilis* and treat these taxa as separate species, but additional collections may show that *M. mento* is best treated as a subspecies of *M. fluviatilis*.

Distribution.—Indonesia (Celebes) and Philippine Is. (Fig. 7). One sample of juveniles was taken with nightlight and dipnet, and at least two lots of subadults-adults are from rivers.

Material Examined.—Sixteen specimens, 57*–115 mm SL, including two presumptive syntypes.

Presumptive Syntypes.—BMNH 1867.11.28.351 (juvenile, 57*) and RMNH 7243 (juvenile, 62*), Manado (Celebes), P. Bleeker.

Other Material.—INDONESIA, Celebes, Manado: CAS 48643 (3, 63.5–67). PHILIPPINE IS., Luzon: MNHN A.1701 (female, 104.5, syntype of *Hemithylacus rocaberti*), MNHN 2085 (2, females, 114.5–116, syntypes of *H. rocaberti*). Mindoro: USNM 137287 (1, 92). Panay: USNM 108466 (female, 115*, holotype of *Parabelonichthys kellersi*), USNM 108468 (2 females, 104.5*–112*) and USNM 119443 (female, 91*), paratypes of *P. kellersi*. USNM 148560 (3, 107.5–115).

Microphis (Belonichthys) spinachioides (Duncker)

Figures 11 and 12

Doryichthys spinachioides Duncker, 1915: 52 (orig. descr.; Kaiserin Augusta River (Sepik R.), New Guinea); Weber and de Beaufort, 1922: 50 (in key, descr. compiled); Duncker and Mohr, 1925: 107, pl. 2, fig. 2 (in pure freshwater, rather active swimmer); Fowler, 1928: 112 (refs., characters compiled); Munro, 1958a: 144 (refs. compiled); Munro, 1967: 153, 156, pl. 17, fig. 259 (in key, characters); Kähnsbauer, 1974: 278 (characters, Papua New Guinea).

Diagnosis.—Snout relatively deep, its depth averages 3.2 in snout length; trunk rings 16; tail rings 26–27; subdorsal trunk rings 6.0–5.5.

Description.—Rings 16 + 26–27, dorsal-fin rays 57–63, pectoral-fin rays 19–20, subdorsal rings 6.0–5.5 + 5.5–6.5 = 11.0–12.5 (see Tables 2–9 for additional counts). Proportional data, based on four specimens 75.0–81.5 ($\bar{x}$ = 79.9) mm SL, follow: HL in SL 5.8–6.2 (6.0), snout length in HL 2.4–2.6 (2.6), snout depth in snout length 3.1–3.5 (3.2), length of dorsal-fin base in HL 0.7–0.8 (0.8), anal ring depth in HL 4.4–6.0 (4.9), pectoral-fin length in HL 4.8–6.1 (5.5). The only examined adult has a supplemental ridge above lateral trunk ridge and on side of distal third or more of tail, but there are no keeled scutella.

A subadult (81.5 mm SL) has a dark stripe on side of snout and a diffuse dark stripe above opercular ridge; lower half of opercle iridescent silvery; dorsum of head mottled brown; side of trunk with irregular stripe-like concentration of dark chromatophores above lateral ridge, darker and more concentrated on subdorsal rings; lower part of trunk and anteroventral part of tail mostly pale; dorsum dark

brown along each side of dorsal-fin base; side of tail gradually darkening posteriorly until distal half of tail is mainly dark brown.

Comparisons.—*Microphis spinachioides* shares the presence of supplemental body ridges and relatively high numbers of dorsal-fin rays and subdorsal trunk rings with other species included in the subgenus *Belonichthys*. However, the single available adult specimen lacks the keeled scutella typically present in adults of *M. fluviatilis* and *M. mento*, and the pouch plates of this brooding fish are more strongly convergent than those of examined brooding males of *M. fluviatilis*. For further comparisons see this section under *M. fluviatilis* and *M. mento*.

Type.—The holotype (juvenile, 82 mm TL), illustrated by Duncker and Mohr (1925, fig. 3), was deposited in the Hamburg Museum (No. 11555) and was destroyed in World War II.

Remarks.—The examined male (149 mm SL) retains a number of poorly preserved pouch larvae, and I estimate that brood-pouch eggs were originally deposited in 5–6 transverse rows. Bilaterally, the pouch plates converge strongly ventromesially, but are separated throughout by a minimum distance of 3–4 mm along the ventral midline.

Distribution.—Known only from the Sepik River, northern Papua New Guinea (Fig. 7). The holotype was taken some 51 airline miles (ca. 108 km) upstream from the river mouth. Some of the present specimens are from the vicinity of Marienberg (ca. 35 km from sea), others are from the vicinity of Angoram, some 30 km or more upstream from Marienberg.

Material Examined.—Five specimens, 75–149* mm SL. PAPUA NEW GUINEA, Sepik R., Marienberg: GCRL 19010 (1, 75), GCRL 19586 (1, 149*). Angoram: GCRL 19862 (2, 81.5), KFRS F.5347.01 (1, 81.5).

Subgenus *Microphis* Kaup

Microphis Kaup, 1853: 234 (type-species, *Syngnathus deocata* Hamilton Buchanan, 1822, by subsequent designation of Jordan, 1919).

Doryichthys (not of Kaup) Duncker, 1910: 27 (in part; type-species *Syngnathus cuncalus* Hamilton Buchanan, 1822, by subsequent designation of Duncker, 1912).

Paramicrophis Klausewitz, 1955: 325 (type-species, *Paramicrophis schmidtii* Klausewitz, 1955 [= *Syngnathus cuncalus* Hamilton Buchanan, 1822], by original designation).

Diagnosis.—Longitudinal opercular ridge present; without supplemental opercular ridges; principal body ridges distinct; without keeled scutella or supplemental body ridges; usually with distinct upper and lower ridges on pectoral-fin base, fin rounded to emarginate; pouch plates perpendicular to somewhat convergent in brooding males; brood-pouch eggs in 2–6 or more transverse rows; snout depth 4.4–7.9 in snout length; tail rings 24–33; total subdorsal rings 6.0–10.5.

Comparisons.—See characters in key, diagnoses, and discussion of subgenera.

Remarks.—The opercular ridge is not elevated strongly, but it is distinct and complete in specimens examined. The lateral snout ridge is poorly defined or obsolete in examples of *M. deocata*, whereas it is distinct and arched somewhat dorsad in other representatives of this subgenus. Similarly, pouch plates are somewhat convergent in brooding males of *M. deocata*, whereas they are essentially perpendicular in examined brooding males of other species.

Kaup (1853) introduced the generic name *Microphis* and listed thereunder the names of two Indian pipefishes with similar lateral ridge configuration (*Syng-*

nathus deocata, *S. cuncalus*) described by Hamilton Buchanan (1822). Kaup (1856) later provided brief descriptions of these species, but failed to diagnose the genus adequately or designate the type-species. Consequently, Duméril (1870) synonymized *Doryichthys* Kaup, 1856 with *Microphis*, and Günther (1870) synonymized *Microphis* with *Doryichthys*. Later, Jordan and Evermann (1896), intending to designate the type-species of *Microphis*, unfortunately introduced a nomen nudum (*M. cuneatus*) through a lapsus calami. This early confusion was further compounded by Duncker's (1910) incorrect use of the preoccupied name *Microphis* for a new genus, with *Syngnathus brachyurus* Bleeker, 1853a as the designated type-species. Hubbs (1929) discussed the impropriety of Duncker's actions, referred *S. brachyurus* to the newly proposed genus *Oostethus* Hubbs, but failed to note that Jordan (1919) had designated *Syngnathus deocata* Hamilton Buchanan, 1822 as the type-species of *Microphis* Kaup, 1853. Most subsequent authors have followed Duncker's (1915) incorrect referral of the two species originally included in *Microphis* Kaup (*deocata* and *cuncalus*) to *Doryichthys* (not of Kaup) Duncker, 1910.

I find *Paramicrophis schmidtii*, the type-species of *Paramicrophis* Klausewitz, 1955, to be conspecific with *Syngnathus cuncalus* Hamilton Buchanan.

Microphis (Microphis) deocata (Hamilton Buchanan)

Figures 13 and 14

Syngnathus deocata Hamilton Buchanan, 1822: 14, 363 (orig. descr.; rivers of northern Bengal and Behar, India); Bleeker, 1853b: 80 (listed); McCulloch, 1929: 90 (type-species of *Microphis* Kaup); Herald, 1943: 104 (probable type-species of *Microphis* Kaup).

Syngnathus deokhata (sic). Gray, 1830: pl. 89, figs. 4, 4a (figs. only).

Microphis deocata. Kaup, 1853: 234 (n. comb.); Kaup, 1856: 64, 76 (descr., largely copied); Hubbs, 1929: 2 (descr. from Kaup, 1853); Herald, 1943: 105 (ref.); Rahman, 1976: 43, 45 (in key; descr.; Dinajpur, Bangladesh).

Syngnathus deokhata. Bleeker, 1854: 107 (comparisons); Jordan, 1919: 254 (type-species of *Microphis* Kaup).

Microphis deokhata. Duméril, 1870: 589 (in key, descr. copied).

Doryichthys deocata. Beavan, 1877: 161 (n. comb., color note, rivers, northern Bengal); Day, 1878: 680 (synon., descr.); Day, 1889: 464, 466 (in key, diagn.); Duncker, 1915: 54 (doubtful species, synon., descr., notes); Shaw and Shebbeare, 1937: 109, pl. 4, figs. 10–11 (descr.; male smaller than female; rivers; Terai and Central Duars, Bengal); Sehgal, 1956: 719, 722, 724 (Assam, Brahmaputra drainage); Breder and Rosen, 1966: 297 (ref.); Doha, 1973: 6, 8 (listed); Sen and Choudhury, 1977: 199, 203 (refs.; meristic data; Marahakowa and Phura rivers, Assam); Sen, 1980: 79, fig. 1 (descr., ecol. note, Assam); Jayaram, 1981: 302 (in key, distr.).

Dorichthys (sic) *deocata*. Hora, 1921: 743 (foothills of eastern Himalayas, below Darjeeling); Menon, 1974: 88 (listed).

Syngnathus (sic) *deokhata*. Sawyer, 1953: 51 (listed).

Diagnosis.—Snout relatively slender, its depth averages 7.2 in snout length; tail rings 29–32; dorsal-fin rays <40; subdorsal trunk rings 2.5–1.75.

Description.—Rings 15–17 + 29–32, dorsal-fin rays 35–36, pectoral-fin rays 19–22, subdorsal rings 2.5–1.75 + 5.0–6.0 = 7.0–8.0 (see Tables 2–9 for additional counts). Proportional data, based on 6 specimens 108.0–124.0 ($\bar{x}$ = 117.5) mm SL, follow: HL in SL 7.0–7.9 (7.4), snout length in HL 1.4–2.0 (1.8), snout depth in snout length 6.8–7.6 (7.2), length of dorsal-fin base in HL 1.1–1.4 (1.2), anal ring depth in HL 4.5–5.6 (5.1), pectoral-fin length in HL 7.5–10.0 (8.0). Anal fin located in a distinct depression and separated from anus by a transverse fleshy septum (Fig. 13).

Males mainly brownish, with indication of a dark lateral stripe on snout and above opercle. Adult females with distinctive Y-shaped markings on lower half of side of trunk (Fig. 14).

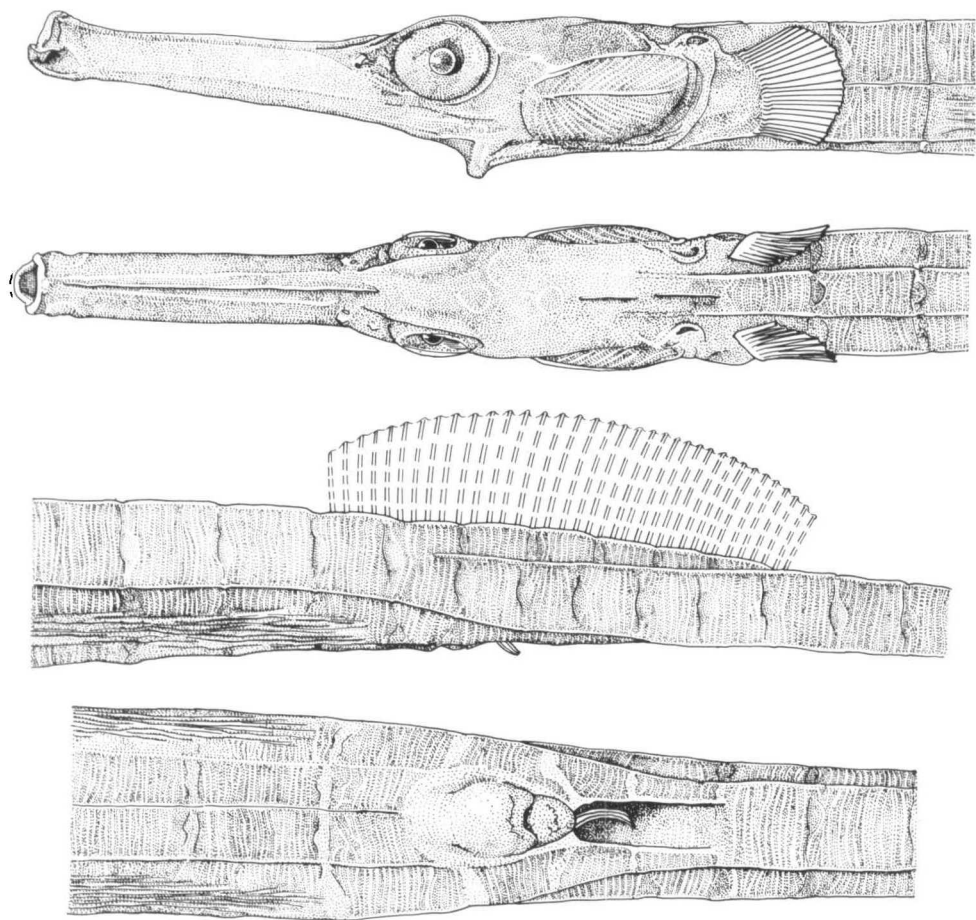


Figure 13. *Microphis deocata*. Lateral and dorsal aspects of head and anterior trunk rings, lateral section of body illustrating ridge configuration and dorsal and anal fins, and ventral section of body illustrating depression surrounding anal-fin insertion. From 112* mm female (ZSI P.11431/1).

Comparisons.—This species is most similar to *Microphis dunckeri* in that both share a relatively slender snout and have essentially the same number of subdorsal rings. However, *M. deocata* has more tail rings (29–32 versus 25–27) and dorsal-fin rays (35–36 versus 29–32), somewhat higher frequencies of pectoral-fin rays (19–22 versus 18–20), and adult females have Y-shaped markings on the trunk (apparently absent in *M. dunckeri*). *Microphis deocata* has a higher average snout depth in snout length ratio than either *M. cuncalus* or *M. cruentus* (7.2 versus 5.8 and 5.2, respectively), it has fewer dorsal-fin rays than *M. cuncalus* (35–36 versus 47–56) and tends to have fewer trunk rings and subdorsal tail rings than *M. cruentus* (see Tables 2, 8).

Type.—Hamilton Buchanan (1822) failed to designate type material and there has been no subsequent neotype selection.

Remarks.—Three brooding males (108–117 mm SL) have 11–17 eggs (approximately 1.6–1.7 mm max. diameter) deposited in two transverse rows under the posterior 8–12 trunk rings. Bilaterally, the brood-pouch plates converge to conceal

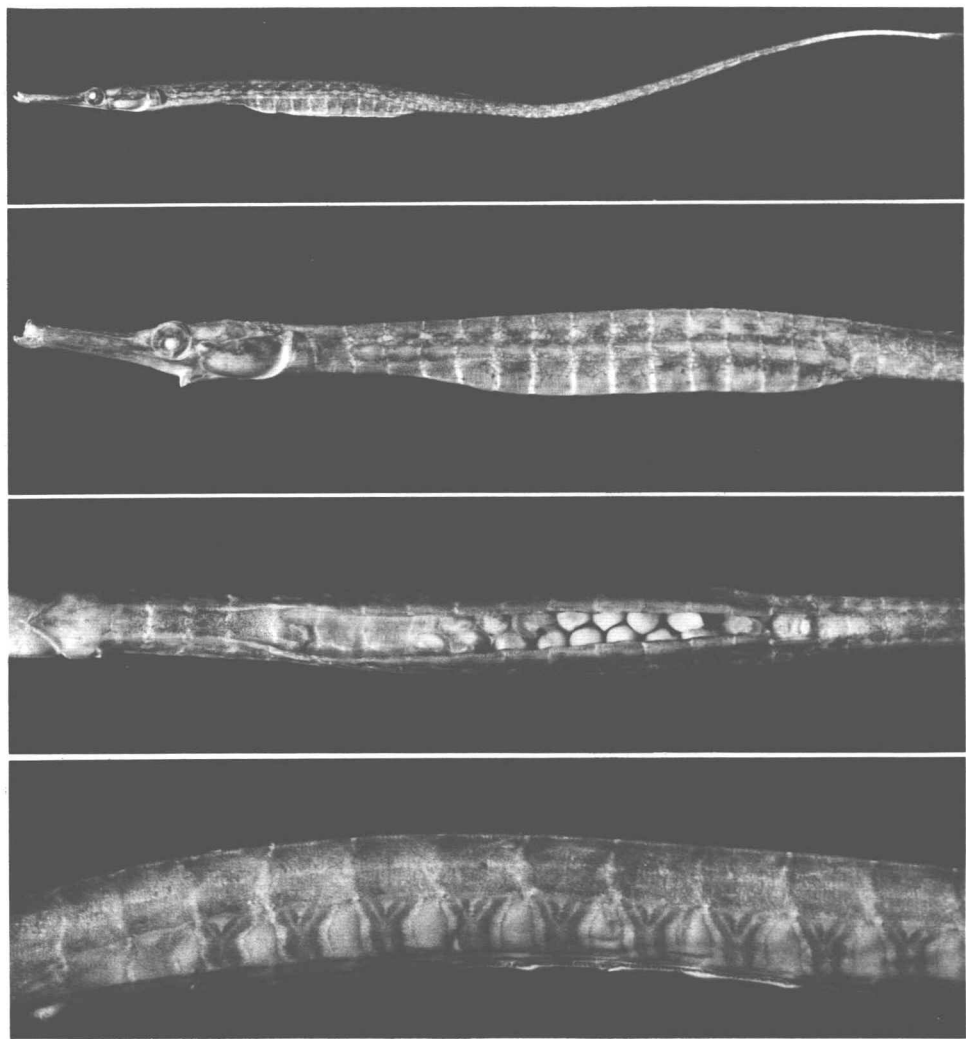


Figure 14. *Microphis deocata* (Hamilton Buchanan), ZSI uncat. Top to bottom: 108 mm SL male; 114 mm SL male; ventral aspect of pouch of brooding male, 117 mm SL, with eggs in situ; section of trunk of adult female, 124 mm SL, illustrating persistent Y-shaped markings.

about half of each row of eggs, but eggs are exposed throughout the median ventral portion of the pouch (Fig. 14).

Sen (1980) gives counts of $16 + 31\text{--}32$ rings, $30\text{--}37$ dorsal- and $17\text{--}21$ pectoral-fin rays, $7\text{--}10$ caudal-fin rays and $6\text{--}9$ total subdorsal rings. She further notes the presence of a ventral projection under the postorbital region of the head and illustrates (Fig. 16) intraspecific differences in the ventral configuration of the snout. Caudal-fin rays are typically 9 in species of *Microphis* and a range of $7\text{--}10$ is indicative of the presence of two or more specimens with regenerated fins. Described differences in morphology of head and snout are artifacts of preservation.

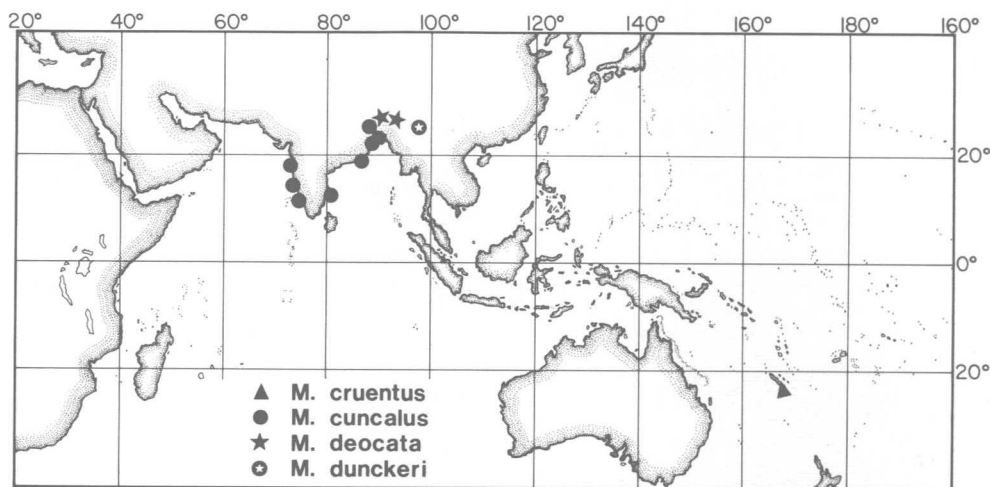


Figure 15. Distributions of species of the subgenus *Microphis* based on material examined.

In life, markings on the trunk of females are variously described as red, blue and white (Gray, 1830; Day, 1878), or generally orange (Rahman, 1976).

Distribution.—Freshwaters of northern India and Bangladesh (Fig. 15). Originally described from northern Bengal and Bihar, *M. deocata* has since been reported from the Panchenai River (Terai), rivers in the Borjhar forest (Central Duars), the eastern Himalayas below Darjeeling, and rivers of Assam in India, as well as from Dinajpur and the Mymensingh district in Bangladesh.

Material Examined.—Seven specimens, 108–124 mm SL, INDIA, northern Bengal, Siliguri: ZSI F.11431/1 (2, 112*–124). Assam, Phura R.: ZSI uncat. (5, 108–124).

Microphis (Microphis) cuncalus (Hamilton Buchanan)

— Figures 16 and 17

Syngnathus cuncalus Hamilton Buchanan, 1822: 12, 362 (orig. descr., estuaries near Calcutta); Bleeker, 1853b: 29, 80 (listed); Breder and Rosen, 1966: 297 (ref.).

Microphis cuncalus. Kaup, 1853: 234 (n. comb., synon.; Malabar, Calcutta); Kaup, 1856: 64, 76 (synon., descr.); Bleeker, 1860a: 72 (listed); Duméril, 1870: 589, 591 (in key, descr.); Hubrecht, 1879: 52 (listed); Hubbs, 1929: 2 (probable type-species of *Microphis* Kaup); Herald, 1943: 105 (name only).

Typhlus Dussumieri Kaup, 1853: 234 (nomen nudum from Bibron MS; compiled in synon. of *M. cuncalus*).

Microphis cunculus (sic). Day, 1865a: 266 (compiled, seas and estuaries of India).

Doryichthys cuncalus. Günther, 1870: 181 (n. comb., descr., Bengal); Day, 1889: 464, fig. 166 (in key, synon., descr., ascends far above tidal influence, attains 7 ins. or more in length); Duncker, 1912: 230 (type-species of *Doryichthys* Duncker, 1910); Duncker, 1915: 52 (synon., descr.; Malabar and Ceylon to Bengal); Hubbs, 1929: 2 (discussion of Duncker's taxonomic treatment); De Silva, 1956: 37 (in key, synon., descr.); Jayaram, 1981: 302 (in key, distr.).

Doryichthys cunculus. Day, 1878: 679, pl. 174, fig. 4 (descr., Bengal and Orissa); Duncker, 1910: 27 (descr., type-species of *Doryichthys* Duncker, 1910; Ceylon); Mendis, 1954: 99 (listed); Menon, 1961: 383 (Ponnaiyar and Gadilam rivers, Cuddalore); Jhingran, 1975: 26 (listed); Rahman, 1976: 43, 45, 49 (in key; descr.; quite common in Meghna River, near Chadpur, Bangladesh); Sen, 1980: 79 (ref.).

? *Microphis cuneatus* Jordan and Evermann, 1896: 773 (nomen nudum, as type-species of *Microphis* Kaup).

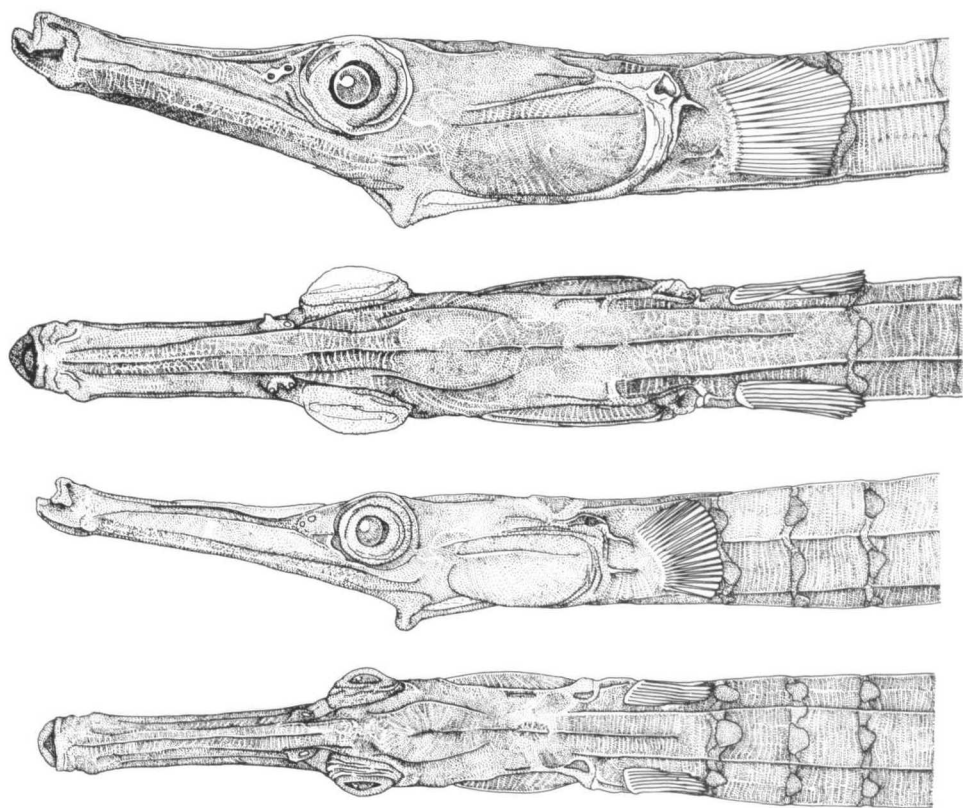


Figure 16. Lateral and dorsal aspects of head and anterior trunk rings. Upper pair: *Microphis cunculus*, from 111 mm SL subadult (CAS-SU 41782). Lower pair: *Microphis dunckeri*, from 104.5 mm SL female (CAS-SU 39750).

Paramicrophis schmidti Klausewitz, 1955: 325, figs. 1a–c (orig. descr.; type-species of *Paramicrophis* Klausewitz, 1955; in brackish water; Bombay, India).

Dorichthys (sic) *cunculus*. Munro, 1955: 82, 83, fig. 223 (in key, diagn., Ceylon); Shiino, 1976: 107 (listed).

Dorichthys (sic) *cunculus*. Qureshi, 1970: 270 (diagn., East Pakistan).

Doryichthys chokderi Rahman, 1976: 45, 47, figs. 1–3 (orig. descr.; Dhaleswari River near Munshiganj [Meghna River system], Bangladesh); Jayaram, 1981: 302 (in key, distr.).

Diagnosis.—Snout relatively deep, its depth averages 5.8 in snout length; tail rings 24–27; dorsal-fin rays >45; subdorsal trunk rings 3.5–2.0.

Description.—Rings 16–18 + 24–27, dorsal-fin rays 47–56, pectoral-fin rays 16–19, subdorsal rings 3.5–2.0 + 5.75–7.5 = 8.5–10.25 (see Tables 2–9 for additional counts). Proportional data, based on 14 specimens 94.0–152.0 ($\bar{x}$ = 122.1) mm SL, follow: HL in SL 7.3–8.8 (8.2), snout length in HL 2.0–2.3 (2.2), snout depth in snout length 4.7–7.0 (5.8), length of dorsal-fin base in HL 0.7–0.9 (0.7), anal ring depth in HL 4.6–6.4 (5.3), pectoral-fin length in HL 4.9–7.0 (5.6). Superior trunk ridges often strongly elevated above intervening dorsum in adult females; some adults with anal fin located in a distinct groove-like depression and separated from anus by a transverse septum.

Study material mostly faded in preservative but some fish retain indications of

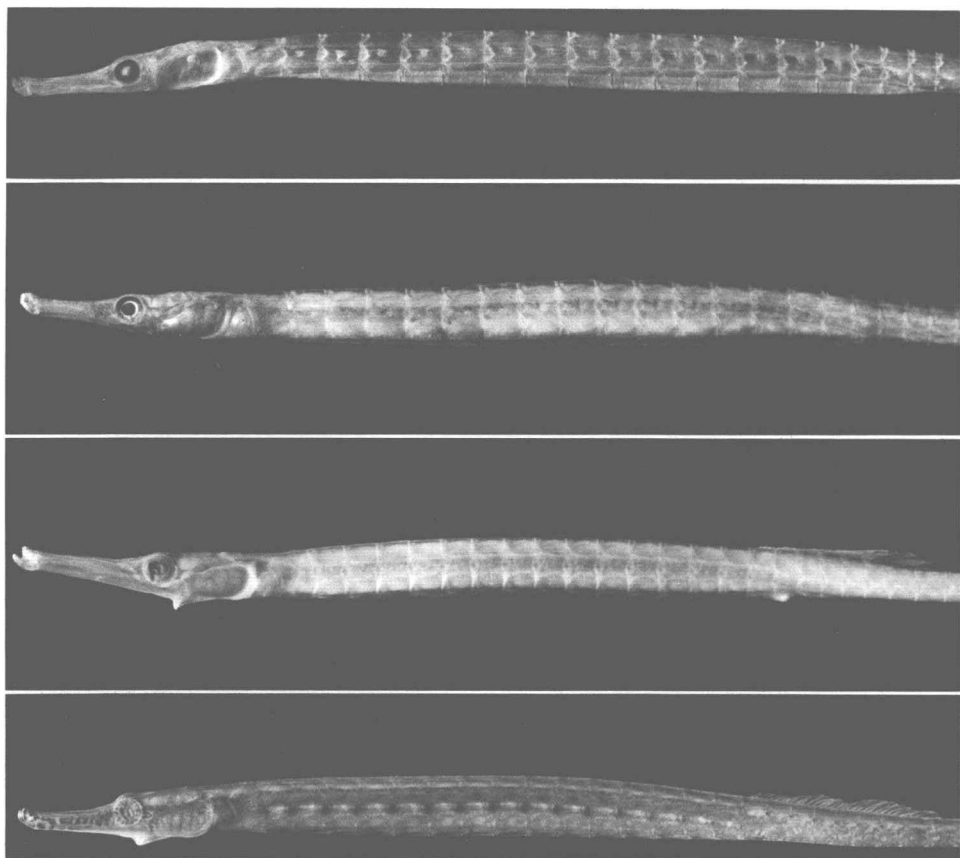


Figure 17. Upper pair: *Microphis cuncalus* (Hamilton Buchanan). Top.—Adult male, 140 mm SL (ZSI P.1062). Bottom.—Adult female, 115* mm (ZSI P.1400/1). Lower pair: Top.—*M. dunckeri* (Prashad and Mukerji), adult female, 106 mm SL (CAS-SU 39750). Bottom.—*M. cruentus* Dawson and Fourmanoir, adult female paratype, 127.5 mm SL (GCRL 17002).

pale spots or blotches, impinging on side and dorsum, near middle of superior ridge of each trunk ring.

Comparisons.—*Microphis cuncalus* is readily distinguished from other members of the subgenus *Microphis* by higher numbers of dorsal-fin rays (47–56 versus 29–36). For additional comparisons, see this section under *M. deocata*, *M. dunckeri* and *M. cruentus*.

Types.—Hamilton Buchanan did not designate type material for *Syngnathus cuncalus*, and there has been no subsequent neotype selection.

I find the holotype (SMF 3743) and 25 paratypes (CAS 14038, GCRL 16248, SMF 3744) of *Paramicrophis schmidtii* to be conspecific with *Microphis cuncalus*. The immature male holotype has a regenerated, 8-rayed, caudal fin.

Remarks.—Among examined material, there are 11 males (130–146 mm SL) with developed brood pouch and persistent traces of egg-compartments, but none retain eggs in situ. Pouch plates are not convergent in these specimens.

Rahman (1976) described *Doryichthys chokderi* as having 16 + 16–19 rings,

50–51 dorsal- and 16–19 pectoral-fin rays, 9–11 total subdorsal rings, and 6–8 caudal-fin rays. The dorsal fin was described as originating on the 16th trunk ring, but an accompanying illustration (Fig. 3) shows the dorsal-fin origin near the middle of the 15th trunk ring and 17 rather than 16 trunk rings. Counts of 6–8 caudal-fin rays are atypical, and counts of 16–19 tail rings are indicative of regenerated caudal fins and tails. Except for numbers of tail rings and caudal-fin rays, described meristic values and measurements agree with those of *Microphis cuncalus*. Although I have been unable to obtain type material for examination, I consider *Doryichthys chokderi* to be based on regenerated specimens of *Microphis cuncalus*.

Distribution.—India, Sri Lanka and Bangladesh (Fig. 15). Originally described from the vicinity of Calcutta, *M. cuncalus* has since been reported from Bombay, Goa, and Malabar in western India, and from Cuddalore, Orissa and Bengal in the east.

Material Examined.—Fifty-seven specimens, ca. 89.5–152 mm SL. INDIA, Bombay: SMF 3743 (male, 137.5, holotype of *Paramicrophis schmidtii*); CAS 14038 (2, 134–144), GCRL 16248 (2, 110.5–117) and SMF 3744 (21, 90–146), paratypes of *P. schmidtii*. Goa: ZSI F.10696/1 (1, 95). Malabar: BMNH 6056 (2, 94–96). Madras: CAS-SU 41782 (9, 98*–133). Orissa: ZSI F.1064 (1, fragmented). West Bengal: ZSI F.1062 (3, 70*–140*), ZSI F.3830-1/1 (2, 130–131), ZSI uncat. (3, fragmented). Bihar (Malda): ZSI F.8506-7/1 (1, 152). Loc. uncertain: Ganges R.: BMNH 1889.2.1.4084-5 (2, 133–139), ZSI F.1400/1 (2, 115*–126*). Bengal: BMNH 1860.3.19.105 (2, 89.5–92), RMNH 7244 (2, fragmented). Orisfir: RMNH 8821 (1, 145). Pulta: CAS-SU 34959 (1, 99).

Microphis (Microphis) dunckeri (Prashad and Mukerji)

Figures 16 and 17

Doryichthys dunckeri Prashad and Mukerji, 1929: 222, pl. 10, fig. 4 (orig. descr.; Namkwang chaung, Kamaing, Myitkyina Dist., Upper Burma).

Dorichthys (sic) *dunckeri*. Menon and Yazdani, 1968: 140 (emendation, compiled).

Doryichthys dunckeri. Sen, 1980: 79 (allied to *D. deocata*); Jayaram, 1981: 302 (in key, distr.).

Diagnosis.—Snout relatively slender, its depth averages 1.9 in snout length; tail rings 25–27; dorsal-fin rays <40; subdorsal trunk rings 2.25–1.5.

Description.—Rings 16–17 + 25–27, dorsal-fin rays 29–32, pectoral-fin rays 18–20, subdorsal rings 2.25–1.5 + 4.5–5.0 = 6.25–6.75 (see Tables 2–9 for additional counts). Proportional data, based on 4 specimens 96.0–106.0 ($\bar{x}$ = 101.5) mm SL, follow: HL in SL 6.4–7.0 (6.7), snout length in HL 1.9–2.0 (1.9), snout depth in snout length 6.5–7.9 (7.2), length of dorsal-fin base in HL 1.4–1.6 (1.5), anal ring depth in HL 5.4–5.7 (5.6), pectoral-fin length in HL 7.1–8.4 (7.8). Anal fin neither located in a distinct depression nor separated from anus by a distinct transverse fleshy septum.

Some specimens with a persistent dark stripe on side of snout and a broad brownish stripe above lateral trunk ridge.

Comparisons.—*Microphis dunckeri* has fewer dorsal-fin rays than *M. cuncalus* (29–32 versus 47–56), fewer tail rings than *M. cruentus* (25–27 versus 30–33), and has a higher average snout depth in snout length ratio than either of these species (7.2 versus 5.8 and 5.2, respectively). For further comparisons, see this section under *M. deocata*.

Type.—The holotype was originally described as having 16 + 32 rings, 32 dorsal- and 18 pectoral-fin rays, 9 caudal-fin rays, 1 + 6 subdorsal rings and a total length of 100 mm. This specimen (ZSI F.11018/1), now in three pieces and otherwise damaged, has 17 rather than 16 trunk rings and 1.5 + 5.0 subdorsal rings. Part

of the tail is missing, 26 rays remain in the damaged dorsal fin, both pectoral fins are damaged, and the specimen is bleached in preservative.

Remarks.—Brooding males are not available for study and pouch plates are not fully developed in the only adult male examined (96 mm SL).

Although treated here as a species, additional collections may show that *M. dunckeri* is best regarded as a subspecies of *M. deocata*.

Distribution.—Known only from the upper Irrawaddy River drainage (Fig. 15).

Material Examined.—Six specimens, 60*–104.5 mm SL, including holotype.

Holotype.—ZSI F.11018/1 (female, 60*), Burma, Myitkyina District, Namkwang stream at Kamaing, B. N. Chopra col.

Other Material.—BURMA, Myitkyina Dist., stream at Kamaing: CAS 39750 (4, 96–106), GCRL 20454 (1, 99.5).

Microphis (Microphis) cruentus Dawson and Fourmanoir Figure 17

Microphis cruentus Dawson and Fourmanoir, 1981: 114, figs. 1–2 (orig. descr.; Dumbéa River, New Caledonia).

Diagnosis.—Snout relatively deep, its depth averages 5.2 in snout length; tail rings 30–33; dorsal-fin rays <40; subdorsal trunk rings 1.5–0.25.

Description.—See Tables 2–9 and Dawson and Fourmanoir (1981).

Comparisons.—This species has a lower average snout depth in snout length ratio than either *M. deocata* or *M. dunckeri* (5.2 versus 7.2). Additionally, *M. cruentus* has more tail rings than *M. dunckeri* (30–33 versus 25–27), tends to have more trunk rings and total rings than *M. deocata* (respectively 16–18 and 47–50 versus 15–17 and 44–48), and lacks convergent pouch plates in brooding males (present in *M. deocata*). *Microphis cruentus* shares the relatively deep snout with *M. cuncalus*, but has more tail rings (30–33 versus 24–27) and fewer dorsal-fin rays (31–36 versus 47–56 in *M. cuncalus*).

Remarks.—Pouch plates are essentially perpendicular in brooding males (126–147 mm SL) and pouch eggs are deposited in 3–6 transverse rows. The smallest examined male with developed pouch is 92 mm SL.

Distribution.—Apparently endemic to New Caledonia (Fig. 15).

Material Examined.—Holotype and 27 paratypes, 82–155 mm SL.

Holotype.—MNHN 1980-1533 (brooding male, 130), New Caledonia, Dumbéa River, elevation ca. 8 m, ca. 8 km upstream from mouth, 1 May 1980, P. Laboute and J.-L. Menou.

Paratypes.—See Dawson and Fourmanoir (1981).

Subgenus *Oostethus* Hubbs

Microphis (not of Kaup, 1853) Duncker, 1910: 26 (in part; type-species, *Syngnathus brachyurus* Bleeker, 1853, by original designation).

Oostethus Hubbs, 1929: 3 (type-species, *Doryichthys lineatus* Kaup, 1856 [= *Syngnathus brachyurus* Bleeker, 1853], by original designation).

Diagnosis.—Longitudinal opercular ridge present; with 1 to several supplemental ridges below the longitudinal opercular ridge, often with 1–2 above; without keeled scutella or supplemental body ridges; usually with distinct upper and lower ridges on pectoral-fin base, fin rounded to emarginate; pouch plates perpendicular to

somewhat convergent in brooding males; brood-pouch eggs in 2–14 transverse rows; snout depth 4.1–13.7 in snout length; tail rings 20–33; total subdorsal rings 6.25–10.75.

Comparisons.—See characters in key, diagnoses and discussion of subgenera.

Remarks.—Longitudinal and supplemental opercular ridges are usually distinct, and the lateral snout ridge is usually arched somewhat dorsad. Margins of principal body ridges are serrate to somewhat spiny in juveniles of some species (e.g., *M. brachyurus*), but margins are usually entire to finely denticulate in subadults-adults. Whereas the caudal fin is not enlarged in most juveniles, oceanic young may have an enlarged fin with exceptionally broad membranes between elongate fin-rays. Pouch plates of brooding males are essentially perpendicular in some species (*M. brachyurus*, *M. insularis*, *M. manadensis*), but plates are somewhat convergent in *M. pleurostictus* and *M. jagorii*.

Two Atlantic subspecies of *M. brachyurus* (*M. b. aculeatus*, *M. b. lineatus*) are the only representatives of the genus *Microphis*, and the subfamily Doryrhamphinae, known to occur outside of the Indo-Pacific region.

Microphis (Oostethus) brachyurus (Bleeker)

Synonymy.—See subspecies.

Diagnosis.—Head length averages <5.5 in SL, snout depth averages 8.0–10.6 in snout length, trunk rings usually 19–21, tail rings 20–26, dorsal-fin rays usually 38–54 (in 99.7%).

Remarks.—Margins of principal body ridges of juveniles often serrate and with a prominent distal spine on each ring. In subadults-adults, the distal spine is usually reduced or obsolete and ridge margins are usually finely denticulate. Pouch plates are essentially perpendicular in brooding males, and brood-pouch eggs are deposited in 2–14 transverse rows.

Distribution.—This is a polytypic species with four recognized subspecies in Atlantic and Indo-Pacific waters.

Microphis (Oostethus) brachyurus brachyurus (Bleeker)

Figure 18

Syngnathus brachyurus Bleeker, 1853a: 3, 5, 16 (orig. descr.; Java and Sumatra); Bleeker, 1854: 70, 76, 105 (descr. compiled); Kaup, 1856: 57 (= *Doryichthys Hasselti*); Bleeker, 1857a: 58, 66 (compiled); Bleeker, 1857b: 476 (compiled); Bleeker, 1858a: 447 (compiled); Hubbs, 1929: 3 (name). *Syngnathus cuncalus* (not of Hamilton Buchanan) Bleeker, 1853b: 162, pl. 3, fig. 3 (misident., descr., fig. incorrect).

Doryichthys Hasselti Kaup, 1853: 233 (nomen nudum); Kaup, 1856: 57, 75 (in part, unwarranted replacement name for *Syngnathus brachyurus*).

? *Doryichthys pristipeltis* Kaup, 1853: 234 (nomen nudum); Kaup, 1856: 58, 76 (orig. descr., loc. unknown).

Doryichthys auronitens Kaup, 1853: 234 (nomen nudum); Kaup, 1856: 59, 76 (orig. descr., Macassar); Bleeker, 1859: 188 (ref. compiled); Bleeker, 1860b: 14 (ref. compiled); Günther, 1870: 182 (descr. compiled).

Syngnathus polyacanthus Bleeker, 1856: 6, 29, 77 (orig. descr., Manado).

Microphis brachyurus. Bleeker, 1859: 188 (n. comb., compiled); Bleeker, 1860a: 63, 72 (ref., synon., distr.); Bleeker, 1860b: 14 (compiled); Duméril, 1870: 589, 595, pl. 26, fig. 4 (in key, refs., descr.); Sauvage, 1891: 528 (listed); Jordan and Seale, 1906: 214, 414, fig. 20 (coloration, freshwater, Samoa); Duncker, 1910: 26 (in part, synon., characters, distr.); Kendall and Goldsborough, 1911: 264 (Kusaie, Caroline Is.); Duncker, 1912: 229 (type-species of *Microphis* Duncker); Snyder, 1912: 408 (Tanegashima); Duncker, 1915: 45 (in part, synon., descr., distr.); Weber and de Beaufort, 1922: 44 (in part, in key, synon., descr., distr.); Evermann and Seale, 1923: 78 (Guadalcanal);

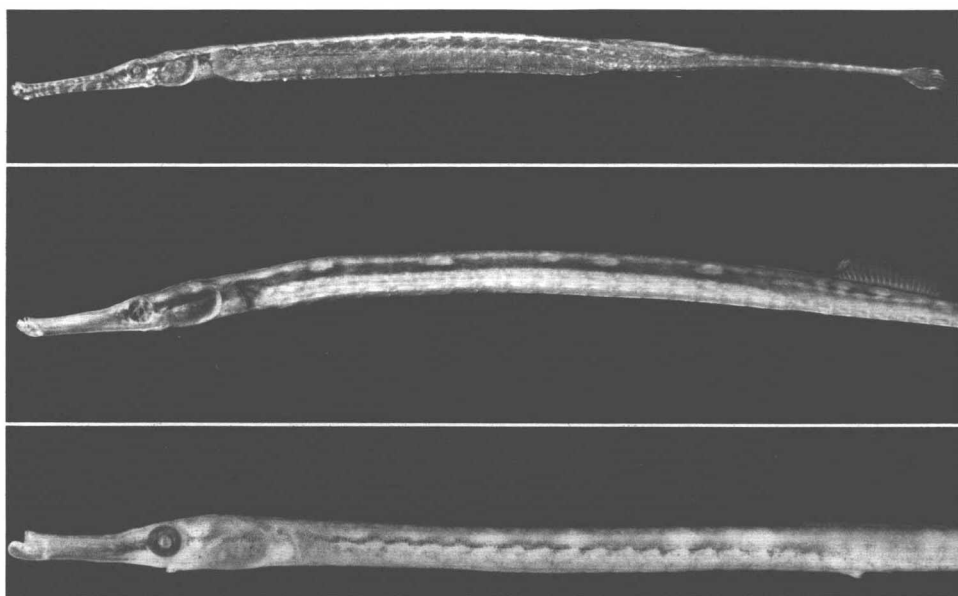


Figure 18. Top: *Microphis brachyurus brachyurus* (Bleeker), adult male, 148 mm SL (GCRL 16106). Middle and Bottom: *M. manadensis* (Bleeker). Middle.—Adult female, 130.5 mm SL (BMNH 1981.11.3.1). Bottom.—Juvenile, 66.5 mm SL (USP uncat.).

Duncker and Mohr, 1925: 106 (coloration, behavior, New Guinea and New Hebrides); Whitley, 1927: 4 (compiled); Hubbs, 1929: 1 (invalid as type of *Microphis*); Pietschmann, 1930: 9 (descr., fresh and salt waters, Tahiti); Herre, 1931a: 10 (compiled); Herre, 1931b: 11 (compiled); Herre, 1932: 3 (compiled); Deraniyagala, 1933: 88 (local names); Fowler, 1934: 397 (refs., Solomon Is., Samoa, Raiatea); Aurich, 1935: 100 (characters, Celebes); Herre, 1935: 164 (compiled); Herre, 1936: 81 (refs., descr., freshwater, Moorea); Roxas and Martin, 1937: 75 (compiled); Fowler, 1938: 136, 275 (synon., refs., distr.); Okada, 1938: 158 (distr., in part); Abe, 1939: 531 (Palau Is.); Herald, 1943: 105 (ref.); Fowler, 1949: 66 (refs.); Bertin and Estéve, 1950: 43 (name); Kähnsbauer, 1950: 269 (characters); Kuroda, 1951: 324 (compiled); Koumans, 1953: 203 (Manado, Amboina); Mendis, 1954: 99 (compiled); Kamohara, 1955: 1 (Koda R., Shikoku I.); Matsubara, 1955: 426 (characters in key); Munro, 1955: 82, pl. 14, fig. 221 (in key, characters); Ogawa, 1957: 424, fig. 2d (descr. of kidney); Munro, 1958a: 143 (synon., refs.); Fowler, 1959: 139, 579 (synon., descr., distr., in part); Sterba, 1959: 612, fig. (descr., euryhaline, care in aquarium); Menon, 1961: 383 (Cuddalore, India); Kamohara, 1964: 23 (compiled); Shiino, 1972: 62 (compiled); Masuda et al., 1975: 184, pl. 25, fig. d (descr.); Shiino, 1976: 109 (compiled).

Microphis ? (sic) *polyacanthus*. Bleeker, 1859: 189 (n. comb., compiled); Bleeker, 1860b: 14 (compiled).

Microphis polyacanthus. Bleeker, 1859–1860: 220 (n. comb., compiled); Bleeker, 1860a: 14, 64, 72 (ref., synon., Sumatra and Celebes); Hubrecht, 1879: 51 (listed).

Syngnathus ? (sic) Jouan, 1863: 178 (descr., New Caledonia).

Microphis Bleekeri Day, 1865a: 265, fig. (orig. descr., river at Cochin); Duméril, 1870: 599 (descr. compiled).

Syngnathus schlegeli (not of Kaup) Day, 1865b: 316 (misident.); Herre, 1953: 214 (note).

Doryichthys brachyurus. Bleeker, 1867: 399 (n. comb., comparisons); Günther, 1870: 184 (synon., descr.); Hubrecht, 1879: 51 (listed); Günther, 1880: 36 (Fiji Is.); Steindachner, 1903: 460 (Ternate); Regan, 1908: 55 (characters, incorrect eastern Pacific loc.); Weber, 1908: 228 (brackish water, New Guinea); Günther, 1910: 433 (synon., characters, range); Schultz, 1943: 71, 73 (characters in key, Samoa); Inger and Kong, 1962: 154 (synon., characters, North Borneo); Tortonese, 1964: 34 (compiled).

Microphis Jouani Duméril, 1870: 589, 592 (in key [as *Jouani*], orig. descr., freshwater, New Caledonia).

Microphis auronitens. Duméril, 1870: 589, 597 (n. comb., in key, synon., descr. compiled).

- Microphis pristipeltis*. Duméril, 1870: 589, 598 (n. comb., in key, descr. compiled); Duncker, 1915: 49 (characters, doubtful species).
- Microphis bleekeri*. Günther, 1870: 182 (emendation, descr. compiled); Day, 1878: 680, pl. 174, fig. 3 (descr., Alwaye R. at Cochín); Day, 1889: 465 (descr.); Jayaram, 1981: 303 (compiled).
- Doryrhamphus brachyurus*. Fowler, 1900: 519 (n. comb., Tahiti); de Beaufort, 1913: 102 (Buru and Ceram); Weber, 1913: 117 (synon., compared with *D. polyacanthus*).
- ? *Trachyrhamphus* sp. Seale, 1906: 17 (Marquesas Is.); Jordan and Seale, 1906: 114 (compiled); Fowler, 1928: 112 (notes).
- Corythoichthys bleekeri*. Seale and Bean, 1907: 240 (n. comb., Philippine Is.); Jordan and Richardson, 1910: 17 (compiled).
- Syngnathus schlegelii* (not of Kaup) Seale and Bean, 1907: 240 (misident., Philippine Is.); Roxas and Martin, 1937: 74 (compiled).
- Siphostoma schlegelii* (not of Kaup) Jordan and Richardson, 1910: 16 (compiled).
- Doryichthys philippinus* Fowler, 1918: 13, fig. 6 (orig. descr., Philippine Is.); Roxas and Martin, 1937: 75 (compiled); Herald, 1953: 231 (= *Oostethus brachyurus*).
- Doryrhamphinarum brachyurum*. Fowler, 1922: 442 (n. comb., Tahiti); Fowler, 1925: 37 (listed); Fowler, 1928: 111, fig. 22 (synon., descr., notes); Fowler, 1931: 323 (refs.); De Silva, 1956: 37 (in key, Ceylon).
- Corythoichthys bleekeri*. Roxas and Martin, 1937: 76 (emendation, compiled).
- Oostethus brachyurus*. Herald, 1940: 59 (n. comb., in key); Herald, 1943: 104, 308 (ridge configuration); Herre, 1953: 211 (in part, synon., refs., distr.); Herre, 1958: 72 (compiled); Fehlmann, 1960: 64, 72, 88, pl. 20, fig. a (characters, estuarine, Palau Is.); Munro, 1967: 153, 156, pl. 17, fig. 257 (in key, characters); Kählsbauer, 1970: 155 (characters, range); Randall, 1973: 182 (Tahitian name); Gray, 1974: 24, fig. (ecol., breeding behavior); Kählsbauer, 1974: 276 (characters, distr., Papua New Guinea); Orsi, 1974: 164 (compiled); Randall et al., 1976: 47 (compiled); Kählsbauer, 1978: 310 (characters, distr., in part); Dawson, 1979: 465 (diag. polytypic sp.); Fritzsche, 1980: 184 (note on Regan's [1908] Tehuantepec record); Ryan, 1980: 61 (Fiji); Bright and June, 1981: 108 (Palau); Dawson and Fourmanoir, 1981: 113 (name only); Dawson, 1982c: 211 (enlarged caudal fin in young).
- Microphis jouani*. Bertin and Estéve, 1950: 42 (emendation, compiled).
- Dorichthys* (sic) *brachyurus*. Inger, 1955: 67 (characters, North Borneo).
- Doryichthys bleekeri*. Rahman, 1976: 43 (n. comb., ref.); Sen, 1980: 79 (ref.).
- Oostethus brachyurus brachyurus*. Dawson, 1979: 467, figs. 1–2 (n. comb., in key, synon., diagn., distr.); Dawson and Fourmanoir, 1981: 118 (freshwater, New Caledonia); Dawson, 1982a: 17 (name only).
- Microphis brachrus* (sic). Khalil, 1980: 32 (ref.).

Diagnosis.—Trunk rings usually 21, total rings average 43, snout depth averages 9.2 in snout length; central Indian Ocean to central Pacific.

Description.—See Dawson (1979).

Comparisons.—See key, diagnoses and Dawson (1979).

Type.—See Dawson (1979) for remarks and lectotype selection.

Remarks.—The smallest examined male with developed brood pouch is 110 mm SL, the smallest brooding male is 120 mm SL. Brood-pouch eggs are in 4–14 transverse rows in 29 brooding males (122–206 mm SL). One male (143 mm SL) has eggs in 6 transverse rows and 77 eggs in the outer right row. Another, 183 mm SL, has eggs in 13 transverse rows with 108 in the outer row.

Distribution.—Central and eastern Indian Ocean (including Sri Lanka, Nicobar Is. and, presumably, southern India) and eastward to Japan (Honshu I.) and Society Is. (Fig. 19). Seale's (1906) record of *Trachyrhamphus* sp. from the Marquesas Is., subsequently identified as *M. brachyurus* by Fowler (1928), has not been confirmed by subsequent collections. A specimen from "New Zealand" (ZMB 9926) is almost certainly labeled incorrectly. Among examined material, juveniles have been taken in harbors with nightlight and dipnet and in offshore plankton or nekton collections. Adults and juveniles are recorded from estuaries, freshwater streams and rivers.

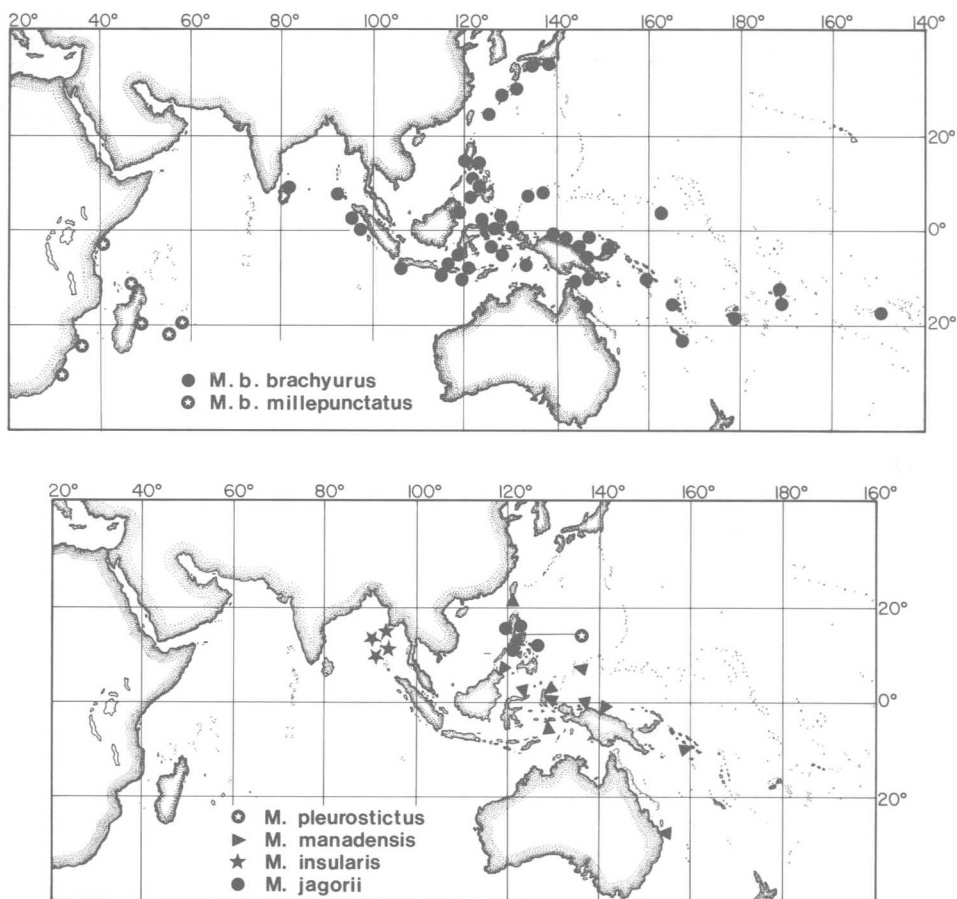


Figure 19. Distributions of Indo-Pacific species and subspecies of the subgenus *Oostethus* based on material examined.

Material Examined.—Two hundred and ninety-one specimens, 64.5–206 mm SL, including lectotype and three paralectotypes.

Lectotype.—RMNH 7249 (female or juvenile male, 106), P. Bleeker.

Paralectotypes.—BMNH 1867.11.28.358 (female, 135) and RMNH 7249 (females, 136* and 136.5), P. Bleeker.

Other Material.—SRI LANKA: SMF 8494 (12, 78.5–99.5), USNM 217830 (1, 80). NICOBAR IS.: SMF uncat. (1, 76). THAILAND: CAS 39704 (1, 85). INDONESIA, Simulue: ZMA 115.724 (6, 122–159), ZMA 115.730 (1, 115.5). Nias: ZMA 115.717 (1, 145.5). Java: RMNH 3852 (1, 181*), ZMA 115.721 (2, 98.5–142). N. Borneo: CAS-SU 32840 (1, 143). Bali: MCZ 30435 (2, 139). Lombok: ZMA 115.733 (1, 82). Celebes: BMNH 1867.11.28.359 (1, 85), CAS 39697 (4, 76–79), CAS-SU 29470 (1, 70), RMNH 3850 (female or juvenile male, 107, holotype of *Doryichthys auronitens*), RMNH 7246 (2 juv., 80.5 and 84*, presumptive syntypes of *Syngnathus polyacanthus*), ZMA 115.716 (3, 110–132.5), ZMA 115.719 (1, 93). Sunda Is.: SMF 8488 (1, 136). Flores: ZMA 115.722 (1, 139.5), ZMA 115.723 (1, 154*). Moluccas: CAS-SU 28049 (1, 73), CAS-SU 29115 (1, 75.5), USNM 215319 (1, 130), USNM 215320 (1, 176*), USNM 215321 (7, 100.5–122), USNM 243313 (1, 180), ZMA 115.720 (1, 140), ZMA 115.725 (1, 122), ZMA 115.731 (1, 103.5), ZMA 115.732 (1, 76.5). Irian Jaya: ZMA 115.715 (1, 123.5), ZMA 115.718 (3, 70*–94.5), ZMA 115.726 (1, 79). Loc. unknown: RMNH 7249 (3, 123.5*–160*), ZMA 115.727 (1, 165), “East Indies,” P. Bleeker. PHILIPPINE IS., Luzon: CAS

39699 (4, 83.5–99), GCRL 16947 (2, 80.5–150). Panay: GCRL 16994 (2, 77–82), USNM 102599 (11, 135.5–172), USNM 102702 (1, 126.5), USNM 102804 (2, 130.5–151.5), USNM 148559 (4, 133.5–153). Negros: CAS-SU 32357 (1, 75.5), CAS-SU 39165 (1, 113), USNM 217561 (1, 125). Mindanao: CAS 39695 (13, 73–90), CAS-SU 39166 (2, 104–105.5), USNM 133170 (4, 78.5–131.5). Loc. unknown: ANSP 47485 (female, 173*, holotype of *Doryichthys philippinus*), NMW 40081 (1, 114). JAPAN, Ryukyu Is.: YCM P.9361 (1, 74). Amami Is.: YCM P.6000 (3, 88.5–107). Tanegashima: GCRL 15552 (1, 130.5), USNM 70721 (3, 126.5–146). Honshu: GCRL 16983 (1, 74.5), IORD uncat. (1, 79), YCM P.5970 (1, 86.5), YCM P.5971 (1, 95.5), YCM uncat. (1, 85.5). CAROLINE IS., Palau Is.: BPBM 8763 (1, fragments only), CAS 14215 (6, 76–148.5), CAS 39686 (1, 143), CAS 39687 (1, 180), CAS 39688 (1, 93.5), CAS 39689 (1, 182), CAS 39690 (1, 93), CAS 39691 (1, 85), CAS 39692 (3, 128.5–184), CAS 39693 (12, 78.5–193), CAS 39694 (6, 80.5–183). Yap Is.: CAS 39701 (1, 117), CAS 39702 (1, 116). Kusaie: MCZ 39401 (1, 128), USNM 65963 (1, 133.5). PAPUA NEW GUINEA: BPBM 15845 (2, 120–145.5), BPBM 15835 (1, 71), USNM 217835 (1, 108.5), USNM 217836 (6, 64.5*–91.5), USNM 217837 (1, 120), USNM 217838 (1, 130), USNM 217840 (1, 90), USNM 217841 (2, 90.5–91.5), WAM P.26738-001 (1, 80), WAM P.27829-011 (3, 121–141). BISMARCK ARCH., Manus: USNM 143634 (1, 134). New Britain: CAS-SU 28217 (1, 108*). AUSTRALIA, Qld.: AMS I.20952-001 (1, 86), QM I.14329 (1, 170.5). SOLOMON IS., Guadalcanal: CAS 2 (1, 174), CAS 24178 (2, 106), CAS 24180 (1, 148), USNM 218828 (2, 104–115). NEW HEBRIDES IS., Espirito Santo: USNM 122840 (17, 94–170.5), USNM 217839 (1, 77). NEW CALEDONIA: MNHN 1519 (male, 197, holotype of *Microphis jouan*), ZMA 115.728 (1, 206). FIJI IS.: GCRL 14094 (5, 125.5–161), USNM 235760 (6, 116–156). SAMOA IS.: BPBM 22530 (1, 182), CAS-SU 8969 (7, 129.5–193), GCRL 16106 (1, 148), USNM 52223 (6, 124–205), USNM 126281 (2, 127–135). SOCIETY IS.: BPBM 8336 (1, 95), CAS 27532 (1, 75), CAS-SU 24710 (4, 81.5–124), FMNH 75873 (3, 174.5–185.5), FMNH 75877 (3, 144.5–165), MCZ 11699 (5, 114–147), MCZ 32173 (2, 131–145), MCZ 35301 (2, 145–155), MCZ 36590 (3, 101–172), MNHN 27-131 (4, 90–148), MNHN 4450 (1, 140*), USNM 89056 (1, 127.5), ZMA 115.729 (4, 121.5–141.5). LOC. UNKNOWN OR DOUBTFUL: MNHN 12-53 (1, 141.5), MNHN 12-54 (1, 120), aquarium fishes. SMF 10052 (1, 142), possibly Java. ZMB 9926 (1, 83.5), "New Zealand, GAZELLE," no other data.

Microphis (Oostethus) brachyurus millepunctatus (Kaup)

Doryichthys millepunctatus Kaup, 1853: 234 (nomen nudum); Kaup, 1856: 60, 76 (orig. descr.; Isle of Bourbon [Réunion I.], Madagascar); Günther, 1870: 183 (descr. compiled); Bleeker, 1874: 75 (compiled); Sauvage, 1891: 528 (compiled).

Doryichthys brachyurus. Bleeker, 1874: 75 (compiled).

Microphis millepunctatus Duncker, 1915: 46 (note, =*M. brachyurus*).

Microphis brachyurus. Pellegrin, 1933: 187 (freshwater, Madagascar); Smith, 1934: 89, fig. 1 (descr., Durban); Smith, 1949: 170, fig. 358 (characters).

Oostethus brachyurus. Smith, 1963: 533, pl. 80, figs. H, I (in part, characters, Durban to Kenya); Smith, 1975: 30 (compiled); Smith, 1980: 175 (compiled).

Oostethus brachyurus millepunctatus. Dawson, 1979: 467, 471 (n. comb., in key, synonym. [in part], neotype selection, range); Dawson, 1982a: 17 (name only).

Diagnosis.—Trunk rings usually 20, total rings average 41, snout depth averages 8.0 in snout length, western Indian Ocean.

Description.—See Dawson (1979).

Comparisons.—See key, diagnoses, and Dawson (1979).

Type.—See Dawson (1979) for remarks and neotype selection.

Remarks.—One brooding male (108 mm SL) has brood-pouch eggs deposited in 6 transverse rows.

Distribution.—East coast of Africa (Kenya to Durban), Madagascar, Mauritius and Réunion I. The eastern limit of this subspecies is uncertain and Sri Lanka and India were provisionally included within the geographic range by Dawson (1979). Study of additional material from Sri Lanka and the Nicobar Is. suggests that the range is restricted to the western Indian Ocean (Fig. 19). Among present material, four collections are from estuaries, one is from a brackish pond and another is labeled "freshwater stream."

Material Examined.—Forty-five specimens, 64.5–153.5 mm SL, including neotype.

Neotype.—MNHN 01-11 (female, 124.5), Madagascar.

Other Material.—KENYA: RUSI 7453 (2, 125*), SOUTH AFRICA: RUSI 3843 (3, 66–108), RUSI 7452 (1, 153.5). MADAGASCAR: BMNH 1920.3.2.2-3 (2, 105.5–111), BMNH 1920.3.2.4 (1, 70.5), MNHN 33-36 (1, 133), MNHN 62-196 (1, 124.5), MNHN 91-671 (1, 122), MNHN 91-672 (1, 131), MNHN B.2884 (7, 66–74), MNHN 1977-60 (18, 64.5–151.5), SMF 3920 (2, 129–133). MAURITIUS: BPBM 20142 (2, 126–128), MNHN 6209 (1, 135). RÉUNION: MNHN 9296 (1, 110*).

Microphis (Oostethus) brachyurus aculeatus (Kaup)

Doryichthys aculeatus Kaup, 1853: 234 (listed, nomen nudum); Kaup, 1856: 61 (orig. descr.; "Egypt," loc. in error); Regan, 1906: 391 (note); Fowler, 1936: 554 (synon., descr.); Poll, 1953: 249, fig. 100 (synon., in part; descr.; Congo); Blache, 1962: 44 (compiled); Daget and Ittis, 1965: 184, fig. 113 (synon., descr., euryhaline, Ivory Coast); Blache et al., 1970: 242, fig. 655 (in key); Thys, 1967: 85, fig. (synon., descr., Fernando Póo); Roman, 1970: 145, figs. 63–64 (synon., descr., Guinea).

Doryichthys sp. Smith, 1867: 227 (probable n. sp., Old Calabar).

Microphis (Doryichthys) aculeatus. Duméril, 1870: 599 (n. comb., compiled).

Microphis (Doryichthys) Smithii Duméril, 1870: 599 (orig. descr., based on Smith [1867]; Old Calabar).

Doryichthys lineatus (not of Kaup). Günther, 1870: 184 (in part, misident.; specs. c–f only).

Doryichthys Falkensteini Reichenow, 1878: 92 (orig. descr., Loango Coast).

Doryichthys (sic) *Juillerati* Rochebrune, 1880: 168 (orig. descr., Dakar and Gorée); Rochebrune, 1883: 151, pl. 6, fig. 5 (descr.).

Microphis aculeatus. Duncker, 1915: 44 (n. comb., synon., descr., distr.); Monod, 1927: 680 (Cameroon); Kählsbauer, 1962: 151, 159 (biol. notes).

Doryichthys juillerati. Metzelaar, 1919: 217 (emendation, ref.).

Doryichthys (sic) *juillerati*. Bertin and Estéve, 1950: 43 (compiled).

Doryichthys macropterus Poll, 1953: 250, fig. 101 (orig. descr.; 07°16'S, 12°17'E, off Ambrizette, Angola); Blache et al., 1970: 242, fig. 654 (in key).

Microphis smithii. Sterba, 1959: 612, fig. (n. comb., descr., reaches 200 mm, freshwater, distr., aquarium fish); Shiino, 1976: 109 (compiled).

Microphis smithii. Smith, 1934: 90 (emendation, comparisons); Thys, 1965: 317 (Fernando Póo).

? *Dorichthys* (sic) spp. Dragovich, 1971: 459 (food item of *Thunnus albacares*).

Syngnathus pulchellus (not of Boulenger) Wheeler, 1975: pl. 236 (misident.).

Oostethus brachyurus aculeatus. Dawson, 1979: 473, fig. 4 (n. comb., synon., diagn., distr.).

Diagnosis.—Trunk rings usually 20, total rings average 43, snout depth averages 10.6 in snout length; eastern Atlantic Ocean.

Description.—See Dawson (1979).

Comparisons.—See key, diagnoses and Dawson (1979).

Remarks.—Among material examined, the smallest male with developed brood pouch is 100 mm SL, and the smallest brooding male (119 mm SL) has pouch eggs deposited in four transverse rows. There are 6–7 transverse rows in two larger fish (124 mm SL), and 9 or 10 rows in the largest examined male (162 mm SL).

Distribution.—West coast of Africa, in marine and freshwaters, from Dakar, Sénégal to Angola. Juveniles have been taken in surface tows or dipnet samples as much as 65 km or more offshore.

Material Examined.—One hundred and seventeen specimens, 82–171 mm SL, including putative holotype.

Holotype.—BMNH 1978.1.16.2 (female, 103*), "Egypt."

Other Material.—SÉNÉGAL, Dakar: MNHN A.2622 (male, 121*, holotype of *Doryichthys juillerati*). LIBERIA: CAS 48407 (2, 96–104), USNM 191739 (28, 97–115), USNM 193280 (4, 103–112.5). GHANA: BMNH 1949.12.8.1-2 (2, 102*–104), CAS 63054 (1, 103), CAS 63055 (1, 110.5), CAS 63056 (3, 104.5–108), CAS 63057 (3, 122–140.5), CAS 63058 (1, 108), FMNH 79927 (1, 139.5), UF

23890 (1, 82), USNM 218847 (1, 102), USNM 220986 (5, 102.5–113). NIGERIA: BMNH 1866.6.26.12 (1, 112), BMNH 1902.11.10.302 (1, 114), BMNH 1938.10.20.27–30 (4, 96–110), BMNH 1950.8.18.1 (1, 155), BMNH 1953.4.28.128 (1, 136.5), BMNH 1956.9.6.104 (1, 104.5), ZMA 115.632 (4, 158–171). CAMEROUN: CAS-SU 17150 (8, 107–121.5), CAS-SU 17151 (6, 104–115), CAS-SU 17152 (8, 105–125), CAS-SU 17153 (9, 97*–145), CAS-SU 19079 (3, 104.5–122.5), CAS-SU 19080 (3, 96.5–128), GCRL 15537 (1, 113.5), MCZ 48150 (3, 100–102). GABON: BMNH 1869.3.26.4 (1, 166). CONGO: BMNH 1901.8.1.155-7 (3, 98–162), BMNH 1912.4.1.477 (1, 110), MNHN 84-60 (1, 106). ANGOLA: IRSNB 196 (juvenile, 117, holotype of *Doryichthys macropterus*). LOC. UNCERTAIN: BMNH 1978.1.16.1 (1, 115*), "Egypt."

Microphis (Oostethus) brachyurus lineatus (Kaup)

Doryichthys lineatus Kaup, 1856: 59 (orig. descr.; Bahia [Brazil], Mexico, Guadeloupe).
See Dawson (1982a) for synonymy.

Diagnosis.—Trunk rings modally 19, snout depth averages 9.0 in snout length; western Atlantic Ocean and Pacific coast of Panama.

Description.—See Dawson (1979, 1982a).

Comparisons.—See key, diagnoses and Dawson (1979).

Type.—See Dawson (1979) for remarks and lectotype selection.

Remarks.—The smallest examined male with developed brood pouch is 83 mm SL and the smallest brooding male is 110 mm SL. See Dawson (1982a) for discussion of geographic variation.

Distribution.—Western Atlantic Ocean (New Jersey to the State of São Paulo, Brazil), and from near the Pacific terminus of the Panama Canal.

Material Examined.—Seven hundred and seventy-four specimens, 34.5–194 mm SL, including lectotype.

Lectotype.—MNHN 6213 (presumptive female, 109), Veracruz, México.

Other Material.—See Dawson (1982a).

Microphis (Oostethus) manadensis (Bleeker)

Figures 18 and 20

Syngnathus manadensis Bleeker, 1856: 6, 29, 78 (orig. descr.; Manado [Celebes]).

Doryichthys manadensis. Bleeker, 1859: 188 (n. comb., compiled); Bleeker, 1860a: 72 (listed); Bleeker, 1860b: 13 (listed); Günther, 1870: 184 (descr.); Hubrecht, 1879: 51 (listed).

Doryichthys Bernsteinii Bleeker, 1867: 397, pl. 21 (orig. descr.; Halmahera [Indonesia]); Weber, 1908: 229 (Mamapiri, New Guinea).

Doryichthys bernsteinii. Günther, 1870: 183 (emendation, descr. copied).

Microphis Bernsteinii. Duméril, 1870: 589, 594 (n. comb., in key, descr. compiled).

Microphis manadensis. Duméril, 1870: 589, 595 (n. comb., in key, descr. compiled); Duncker, 1915: 47 (synon., descr., distr. in part); Weber and de Beaufort, 1922: 44, 46 (synon., descr., fresh and brackish waters, distr. in part); Duncker and Mohr, 1925: 106 (Langemak Bay, New Guinea); Herre, 1934: 29 (listed); Fowler, 1934: 397 (name only); Munro, 1958b: 89 (characters, Qld.); Lee, 1983: 73, tabs. 1–2, fig. 7 (characters, Taiwan).

Syngnathus bernsteinii. Hubrecht, 1879: 51 (n. comb., listed).

Doryichthys menadensis (sic). Weber, 1895: 275 (freshwater, Ambon).

Doryichthys stictorhynchus Ogilby, 1912: 34 (orig. descr.; Moreton Bay, Qld.); Duncker, 1915: 45 (= *Microphis brachyurus*); Dawson, 1979: 469 (= *Oostethus manadensis*).

Microphis brachyurus (not of Bleeker) McCulloch and Whitley, 1925: 137 (listed); McCulloch, 1929: 90 (listed); Marshall, 1964: 114 (characters, in part; Qld.); Marshall, 1966: 176 (coloration).

Doryrhamphinarum manadensis. Fowler, 1928: 112 (n. comb., synonym.); Munro, 1958a: 143 (listed).

Oostethus manadensis. Herald, 1943: 11 (n. comb., probably eats mosquito larvae); Herre, 1953: 212 (in part, synonym., refs., distr.); Munro, 1967: 153, 156 (characters, entering freshwater); Gray, 1974: 25 (Guadalcanal).

Microphis stictorhynchus. Whitley and Allan, 1958: 60 (n. comb., Qld.); Whitley, 1964: 38 (listed).

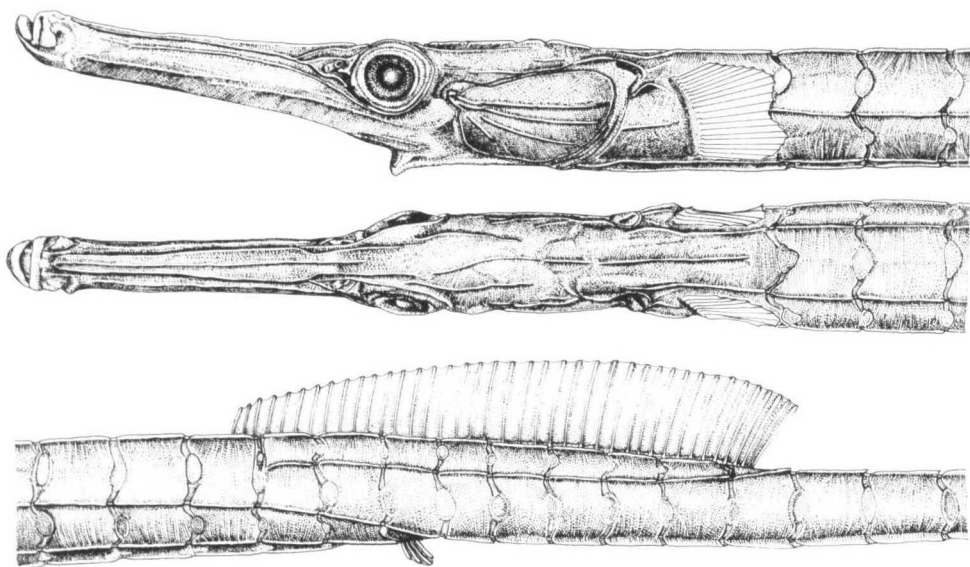


Figure 20. *Microphis manadensis*. Lateral and dorsal aspects of head and anterior trunk rings, together with section of body illustrating ridge configuration and dorsal and anal fins. From 169 mm SL female (CAS 52310).

Diagnosis.—Head length averages 6.6 in SL, snout depth averages 6.7 in snout length, trunk rings modally 21, dorsal-fin rays usually >38.

Description.—Rings 20–22 + 24–26, dorsal-fin rays 37–44, pectoral-fin rays 18–21, subdorsal rings $3.25\text{--}2.0 + 6.0\text{--}7.25 = 8.25\text{--}10.25$ (see Tables 2–9 for additional counts). Proportional data, based on 11 specimens 60.5–192.5 ($\bar{x} = 132.0$) mm SL, follow: HL in SL 6.0–7.3 (6.6), snout length in HL 1.8–2.0 (1.9), snout depth in snout length 5.4–8.4 (6.7), length of dorsal-fin base in HL 1.0–1.2 (1.1), anal ring depth in HL 4.4–6.7 (5.7), pectoral-fin length in HL 6.4–7.2 (6.8). Superior trunk ridges not strongly elevated, the margins finely denticulate to entire.

With a dark lateral stripe on snout, postorbital, and upper part of opercle; side of trunk with a broad dark stripe above lateral ridge, impinged on above by 5–6 pale blotches.

Comparisons.—*Microphis manadensis* has more trunk rings than either *M. pleurostictus* or *M. insularis* (20–22 versus 17–19), and further differs in having fewer tail rings than *M. insularis* (24–26 versus 30–33), and in having a higher average snout depth in snout length ratio than *M. pleurostictus* (6.7 versus 4.3). This species has a lower average snout depth in snout length ratio than *M. brachyurus* ssp. (6.7 versus 8.7–10.6) and tends to have higher frequencies of total rings (45–47 versus 39–44 in 95% of examined *M. brachyurus* ssp.). For further comparisons, see this section under *M. jagerii*.

Types.—Bleeker's (1856) description of *Syngnathus manadensis* was based on five juveniles (66–80 mm TL). There are now four Bleeker specimens in RMNH 7248 and one in BMNH 1867.11.28.357 which fall within this length range and are here considered syntypes. The latter specimen is marked with orange paint and there is a pencil-marked fish (72.5 mm SL) among the RMNH specimens. Of

these, the latter is probably the model for the illustration of *Doryichthys manadensis* (Pl. 451, fig. 9) in Bleeker's unpublished Atlas.

The holotype of *Doryichthys bernsteini* (RMNH 7245) is conspecific with *Microphis manadensis*, and the illustration accompanying the original description (Bleeker, 1867, pl. 21) is also included in the unpublished Atlas (Pl. 451, fig. 3).

The holotype of *Doryichthys stictorhynchus* (QM 1552) is also conspecific with *Microphis manadensis*.

Remarks.—Present material includes five adult males (153–183 mm SL). Two, with eggs in situ or membranous egg-compartments, lack convergent pouch plates, whereas another has slightly convergent plates which bilaterally conceal about half of the outermost of 4 transverse rows of compartments. There are 6 transverse egg-rows in one male (179.5 mm SL), and another (183 mm SL) has eggs in 8 transverse rows with ca. 69 eggs in the outer right row.

Juveniles, like those of *M. jagorii* and *M. brachyurus* ssp., may have 3–4 broad brownish bands on the tail.

Although poorly represented in collections, *M. manadensis* has been taken with specimens of *M. b. brachyurus*, *M. brevidorsalis*, *M. leiaspis* and *M. retzii*.

Distribution.—Indonesia, Taiwan, Palau Is., New Guinea, Australia (Qld.) and the Solomon Is. (Fig. 19). Five examined collections are from freshwater rivers or streams, and the specimen from Taiwan was taken some 30 km up the Hsiatamshui R. (S.-C. Lee, pers. comm.). The type locality of *Doryichthys stictorhynchus* (27°25'S, near Brisbane) appears questionable, due to its geographic relationship to other records and the apparent absence of this species from subsequent Australian collections.

Material Examined.—Twenty-two specimens, 60–192.5 mm SL, including five juvenile syntypes.

Syntypes.—BMNH 1867.11.28.357 (1, 66), RMNH 7248 (4, 60–72.5), Manado, Celebes, P. Bleeker.

Other Material.—INDONESIA, N. Borneo: BMNH 1893.3.6.281 (1, 183). Celebes, Manado: CAS 39698 (5, 72.5–77). Halmahera: GCRL 19592 (1, 151), RMNH 7245 (female, 192.5, holotype of *Doryichthys bernsteini*). Ambon: ZMA 104.660 (1, 179.5). TAIWAN: IZT uncat. (1, 153). PALAU IS.: CAS 52310 (1, 169). IRIAN JAYA: ZMA 104.661 (1, 81), ZMA 104.662 (1, 104*). PAPUA NEW GUINEA: AMNH 20151 (1, 164.5). AUSTRALIA, Qld.: QM 1552 (male, 170, holotype of *Doryichthys stictorhynchus*). SOLOMON IS., Guadalcanal: USP uncat. (1, 66.5). Loc. uncertain: BMNH 1981.11.3.1 (1, 130.5).

Microphis (Oostethus) pleurostictus Peters Figures 21 and 22

Microphis pleurostictus Peters, 1869b: 278 (orig. descr.; Batu (Bato) Lake, Südcamarines (Camarines) Prov. and Yassot Creek, Albay Prov., Luzon); Duméril, 1870: 589, 593 (descr., in part); Jordan and Richardson, 1910: 17 (compiled); Fowler, 1918: 14 (allied with *M. philippinus*).

Doryichthys pleurostictus. Günther, 1870: 185 (n. comb., diagn.); Boulenger, 1895: 187 (listed); Duncker, 1915: 50 (descr.); Roxas and Martin, 1937: 75 (compiled); Herre, 1953: 207 (compiled); Kähnsbauer, 1978: 309 (descr.).

Diagnosis.—Head length averages 5.6 in SL, snout depth averages 4.3 in snout length, trunk rings modally 18, tail rings 21–24, dorsal-fin rays <38.

Description.—Rings 17–18 + 21–24, dorsal-fin rays 28–36, pectoral-fin rays 18–21, subdorsal rings 2.25–1.25 + 4.75–5.5 = 6.25–7.5 (see Tables 2–9 for additional counts). Proportional data, based on 8 specimens 64.0–112.0 ($\bar{x}$ = 87.6) mm SL, follow: HL in SL 4.9–6.6 (5.6), snout length in HL 1.9–2.2 (2.1), snout depth in snout length 3.8–4.8 (4.3), length of dorsal-fin base in HL 1.2–1.9 (1.6),

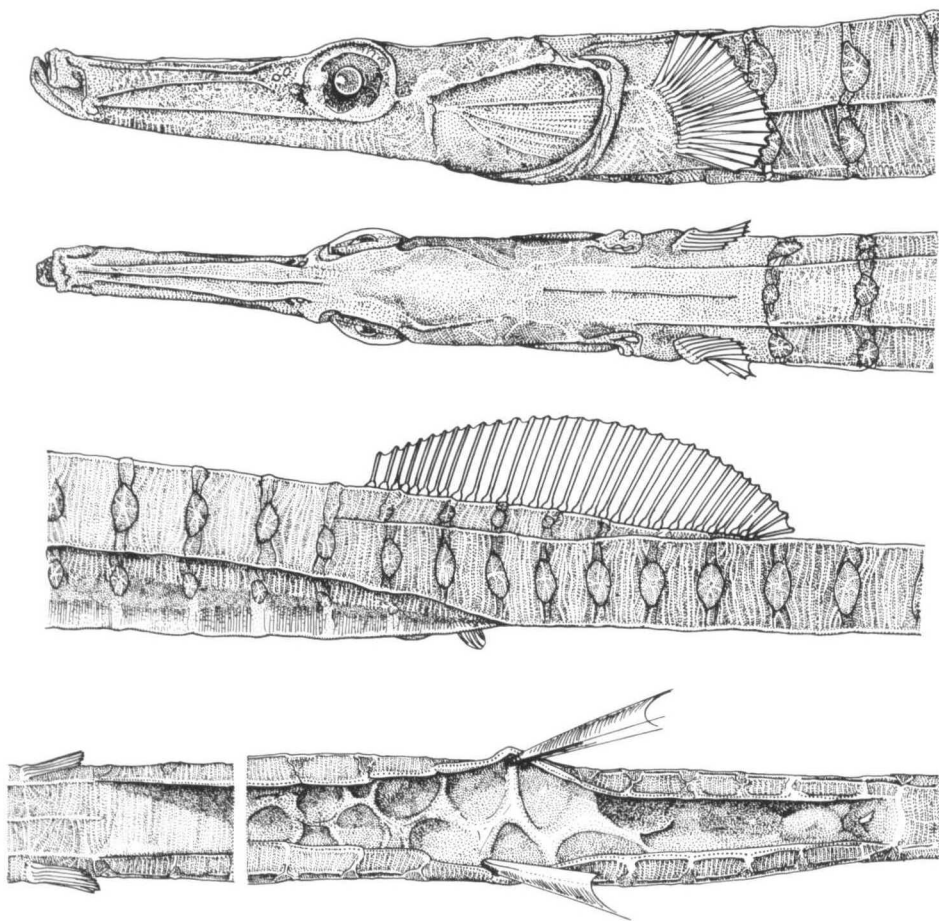


Figure 21. *Microphis pleurostictus*. Lateral and dorsal aspects of head and anterior trunk rings, lateral section of body, and ventral aspect of pouch of brooding male. Head and lateral views from 94 mm SL male, pouch from 93* mm male (ZMB 6633, presumptive syntypes).

anal ring depth in HL 3.8–5.8 (5.0), pectoral-fin length in HL 7.3–9.0 (7.8). Superior trunk ridges not clearly elevated, the margins entire to finely denticulate.

Study material faded in preservative. Some specimens retain traces of small, vertically elongate, dark blotches located between rings along the lateral trunk ridge.

Comparisons.—*Microphis pleurostictus* has a lower snout depth in snout length ratio than *M. brachyurus* and *M. manadensis* (3.8–4.8 versus 5.4–13.2), and has fewer dorsal-fin rays than examined representatives of these species (27–36 versus 37–54). The modal count of 18 trunk rings is shared with *M. insularis*, but *M. pleurostictus* has fewer tail rings (21–24 versus 30–33) and has a higher average length of dorsal-fin base in HL ratio (1.6 versus 1.0). Although similar to *M. jagorii*, *M. pleurostictus* has a lower average snout depth in snout length ratio (4.3 versus 5.8), a higher average length of dorsal-fin base in HL ratio (1.6 versus 1.1),

fewer trunk rings (17–18 versus 18–21), and fewer total rings (39–42 versus 41–46 in *M. jaborii*).

Types.—Peters (1869b) did not specify the number of specimens included in his original description, but did provide measurements of a male and a female (respectively, 92 and 95 mm TL) and implied that several specimens were available for study. I find three lots of specimens which may be considered as presumptive syntypes. One of these (ZMB 6633) is from Yassot Creek, whereas the other two (BMNH 1868.7.10.1; MNHN 6036) are labeled as originating from Luzon I. Kähnsbauer's (1978) reference to three syntypes in ZMB 6635 is apparently in error.

Remarks.—The presumptive syntypes include four males (77.5–94 mm SL) with developed or developing brood pouch. None retain eggs in situ but one (ca. 93 mm SL) has somewhat convergent pouch plates and two rows of large membranous egg-compartments (ca. 2 mm diameter) below the 8th–15th trunk rings.

Peters (1869b) gave a count of 8 caudal-fin rays in his original description and the count is 8 in 10 of the presumptive syntypes, 7 in one, and 9 in two others. I find no clear evidence of regeneration in fish with 7–8 caudal-fin rays, but this count is typically 9 in species of *Microphis* and specimens with 7–8 rays may well have regenerated tails. Nevertheless, the species is clearly differentiated by characters other than frequencies of tail rings, and the two fish with 9 caudal-fin rays have 24 tail rings.

Distribution.—Apparently endemic to the Philippine Is. (Fig. 19) and known only from the type localities, Lake Bato and Yassot Creek, Luzon I.

Material Examined.—Thirteen presumptive syntypes, 49–112 mm SL. PHILIPPINE IS., Luzon I., Yassot Bay: ZMB 6633 (5, 86–112). Luzon I., Loc. unknown: BMNH 1868.7.10.1 (5, 49–84.5), MNHN 6036 (3, 74–87).

Microphis (Oostethus) insularis (Hora)

Figures 22 and 23

Doryichthys insularis Hora (in Annandale and Hora), 1925: 38, pl. 2, fig. 1 (orig. descr.; stream at Birchgunge, S. Andaman I.); Hora, 1925: 467 (Corbyn's Cove, S. Andamans); Sen, 1980: 79, 82 (allied to *D. deocata*).

Doryichthys (sic) *insularis*. Menon and Yazdani, 1968: 140 (syntypes listed in part, ZSI F.10705/1 only).

Diagnosis.—Head length averages 9.1 in SL, snout depth averages 4.7 in snout length, trunk rings modally 18, tail rings 30–33, dorsal-fin rays usually <38.

Description.—Rings 17–19 + 30–33, dorsal-fin rays 32–38, pectoral-fin rays 17–19, subdorsal rings 1.75–0.5 + 5.5–7.5 = 6.75–8.0 (see Tables 2–9 for additional counts). Proportional data, based on 17 specimens 68.0–149.0 ($\bar{x}$ = 106.1) mm SL, follow: HL in SL 8.2–10.0 (9.1), snout length in HL 2.0–2.3 (2.2), snout depth in snout length 4.1–5.5 (4.7), length of dorsal-fin base in HL 0.9–1.1 (1.0), anal ring depth in HL 3.8–5.9 (4.6), pectoral-fin length in HL 5.0–6.6 (5.7). Superior trunk ridges distinctly elevated above intervening dorsum, the margins finely denticulate in adults.

Side of snout with irregular dark bars or blotches; usually with a dark stripe on postorbital and along upper part of opercle; lateral trunk and tail ridges often pale, usually with small dark spots or blotches on lateral ridge between most trunk rings.

Comparisons.—Compared to other taxa in this subgenus, *M. insularis* is distinguished by the combination of a higher average HL in SL ratio (9.1 versus 4.7–

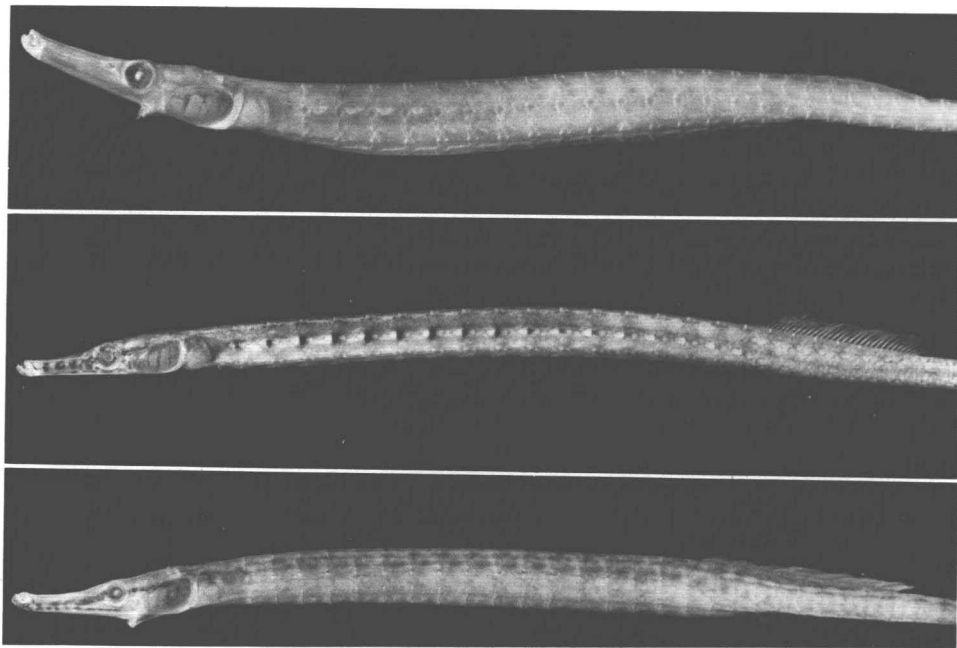


Figure 22. Top: *Microphis pleurostictus* Peters, adult female, presumptive syntype, 112 mm SL (ZMB 6633). Middle: *M. insularis* (Hora), adult female, 119 mm SL (GCRL 16263). Bottom: *M. jagorii* Peters, adult female, 123.5* mm (GCRL 20428).

7.2), higher numbers of tail rings (30–33 versus 20–26), and presence of dark spots on the lateral trunk ridge.

Types.—Hora (in Annandale and Hora, 1925) described *Doryichthys insularis* from 6 specimens (without brood pouch) collected among *Potamogeton* sp. in a pool of a rapidly flowing stream at Birchgunge, S. Andaman I. He gave measurements of two specimens (81.4 and 97.0 mm TL) and his illustration of the “type-specimen” is of a fish approximately 138.6 mm TL. Later, Hora (1925) noted the collection of two additional specimens from a rocky stream at Corbyn’s Cove, and stated that the 6 original specimens were collected by Dr. Annandale.

Menon and Yazdani (1968) list two lots of syntypes and one of these, represented by the two fish from Corbyn’s Cove (ZSI F.10706/1), is obviously listed in error. The other lot (ZSI F.10705/1), labeled “coral reef at Aberdeen, S. W. Kemp,” is either mislabeled or the included specimens are not syntypes. There are 5 damaged fish (66.5*–95*) in this lot, all have 18 trunk rings as originally described, one has 32 dorsal-fin rays rather than the described values of 34–35, and one is a male with developing brood pouch. Despite these discrepancies and lack of extant information on the fate of the 6th specimen, I believe that these fish must be treated as presumptive syntypes.

Remarks.—Among examined material, there are four males (95*–149 mm SL) with developed brood pouches. None have eggs in situ, but one fish (108 mm SL) has 4 transverse rows of membranous egg-compartments, 25–26 in the outer left row, and pouch plates are essentially perpendicular.

Distribution.—Apparently endemic to the Andaman Islands (Fig. 19). The syntypes and 8 other lots are recorded from rivers or streams.

Material Examined.—Seventy-seven specimens, 61.5–149 mm SL, including five presumptive syntypes.

Presumptive Syntypes.—ZSI F.10705/1 (5, 66.5*–95*), Andaman Is. (see remarks under “Types” above).

Other Material.—ANDAMAN IS., North Andaman: IRSNB 18877 (1, 85.5). Middle Andaman: IRSNB 18869 (9, 64.5–117). South Andaman: CAS-SU 37191 (6, 76.5–89.5), GCRL 16262 (1, 149), GCRL 16263 (2, 114–119), GCRL 16264 (2, 63–108), IRSNB 18870 (2, 64–68), IRSNB 18872 (3, 131–138), IRSNB 18873 (25, 66–105.5), IRSNB 18874 (10, 85–121), IRSNB 18875 (1, 66), IRSNB 18876 (7, 63–112), ZSI F.10706/1 (2, 80*–85*). Little Andaman: IRSNB 18871 (1, 61.5).

Microphis (Oostethus) jagorii Peters

Figures 22 and 24

Microphis Jagorii Peters, 1869b: 280 (orig. descr., Samar I. [Philippine Is.]); Duméril, 1870: 589, 594 (in key, descr. compiled); Duncker, 1915: 47 (= *M. manadensis*).

Microphis jagorii. Jordan and Richardson, 1910: 17 (emendation, listed); Roxas and Martin, 1937: 75 (compiled).

Microphis manadensis. Duncker, 1915: 47 (misident., in part; Philippine Is.); Fowler, 1918: 14 (allied with *M. philippinus*); Weber and de Beaufort, 1922: 47 (Samar); Aurich, 1935: 100 (descr., Mindoro and Luzon); Roxas and Martin, 1937: 75 (compiled); Herre, 1940: 203 (feeds on mosquito larvae); Herre, 1953: 212 (in part, Philippine Is. only); Herre, 1958: 72 (listed).

? *Microphis pristipeltis* (not of Kaup) Kählsbauer, 1950: 269 (probable misident.).

Oostethus manadensis (not of Bleeker) Kählsbauer, 1978: 310 (misident.; data from holotype of *Microphis jagorii*).

Diagnosis.—Head length averages 7.2 in SL, snout depth averages 5.8 in snout length, trunk rings modally 20, tail rings 23–26, dorsal-fin rays usually <38.

Description.—Rings 18–21 + 23–26, dorsal-fin rays 33–40, pectoral-fin rays 18–22, subdorsal rings 3.0–1.5 + 4.75–6.75 = 7.0–9.25 (see Tables 2–9 for additional counts). Proportional data, based on 35 specimens 48.5–166.5 ($\bar{x}$ = 105.8) mm SL, follow: HL in SL 5.8–8.0 (7.2), snout length in HL 1.9–2.3 (2.1), snout depth in snout length 4.1–7.4 (5.8), length of dorsal-fin base in HL 1.0–1.2 (1.1), anal ring depth in HL 4.2–6.7 (5.2), pectoral-fin length in HL 6.0–7.5 (6.6). Superior trunk ridges not strongly elevated, the margins entire to minutely denticulate.

Study material largely faded in preservative, but some fish retain irregular bars on side of snout and a dark stripe above the lateral trunk ridge.

Comparisons.—This Philippine Is. population is similar to *M. manadensis*, but differs in having modally fewer trunk rings (20 versus 21), and in having somewhat fewer dorsal-fin rays (33–40 versus 37–44) and total subdorsal rings (7.0–9.25 versus 8.25–10.25 in *M. manadensis*). Additionally, present data suggest that *M. jagorii* has a higher average HL in SL ratio (7.2 versus 6.6) and a lower average snout depth in snout length ratio (5.8 versus 6.7 in *M. manadensis*). For further comparisons, see key, diagnoses and this section under *M. pleurostictus*.

Type.—Peters (1869b) based his description on a single female specimen (146 mm TL) and gave counts of 21 + 25 rings, 37 dorsal-fin rays, 20 pectoral- and 9 caudal-fin rays. My counts from the holotype (ZMB 6647) agree, except that I count 24 tail rings, and 19 and 20 rays in the two pectoral fins.

Remarks.—Among examined material, the smallest male with developing brood pouch is 112 mm SL, and four brooding males (121.5–166.5 mm SL) have eggs deposited in 3–5 transverse rows. The smallest of these has the pouch plates converging ventromesially to bilaterally conceal half or more of the outermost of five transverse egg-rows, and there are ca. 45 eggs in the outermost rows. Juveniles

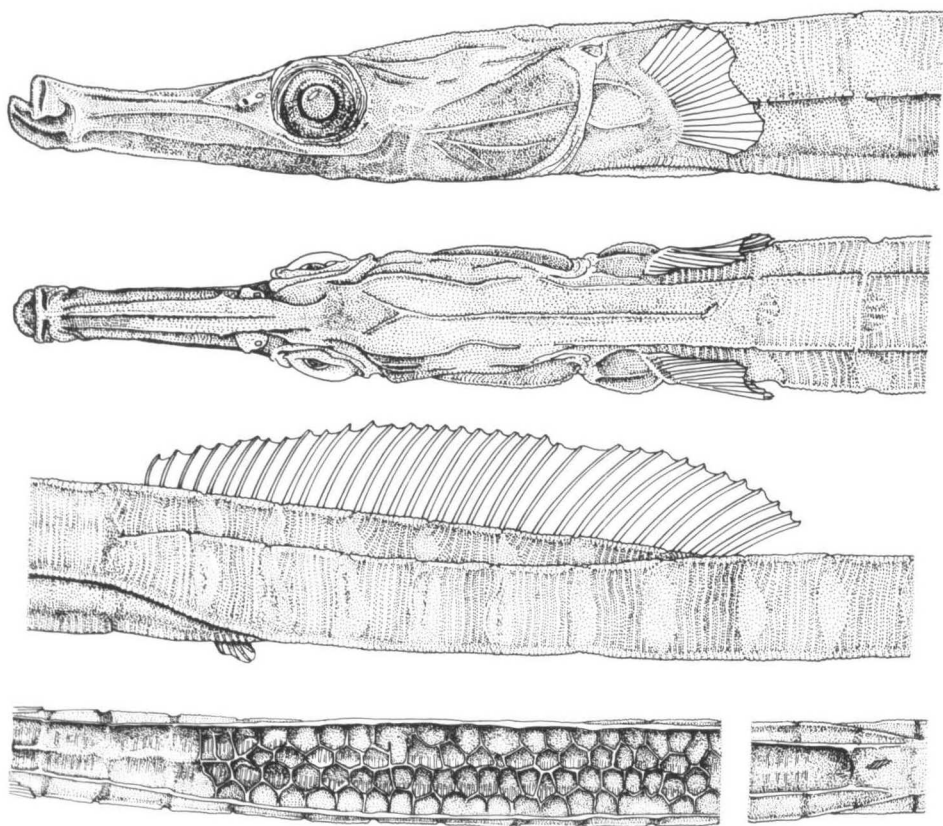


Figure 23. *Microphis insularis*. Lateral and dorsal aspects of head and anterior trunk rings, lateral section of body, and ventral aspect of brood pouch. From 108 mm SL male (GCRL 16264).

(50–53 mm SL) may have 3 broad brown bands on the tail and an enlarged caudal fin.

Fourteen specimens from Lake Taal (GCRL 20428) have $18-20 + 23-24 = 41-44$ rings, eleven of these have 19 trunk rings, and tail ring values are equally 23 and 24. Among 60 specimens from other localities, trunk rings are 19–21 (modally 20), 43 fish (72%) have 25–26 tail rings and only one has a count of 23. Despite relatively low numbers of rings, the Lake Taal specimens do not materially differ in other meristic values or morphology and are considered to be conspecific with *M. jagorii*. Although here regarded as separate species, further studies of Philippine populations may show that *M. jagorii* and *M. pleurostictus* are best treated as subspecies of *M. manadensis*.

Distribution.—Known only from fresh or brackish waters of the Philippine Is. (Fig. 19). One juvenile was taken with nightlight and dipnet, 9 lots are from rivers or streams, 8 are from Laguna de Bay, and one is from Lake Taal.

Material Examined.—Eighty-eight specimens, 47.5–166.5 mm SL, including holotype.

Holotype.—ZMB 6647 (female, 140), Loquilocun, Samar I. (Philippine Is.), F. Jagor.

Other Material.—PHILIPPINE IS., Luzon: BMNH 1933.3.11.193.5 (3, 105–141.5), CAS 7073 (1,

117), CAS 52311 (1, 87), CAS-SU 27693 (7, 84.5–166.5), CAS-SU 32839 (1, 101*), CAS-SU 39167 (11, 57–139), CAS-SU 39168 (1, 71.5), CAS-SU 39169 (3, 70.5–91.5), CAS-SU 39170 (3, 48.5–79), CAS-SU 39171 (2, 84–91), CAS-SU 39172 (1, 89.5), CAS-SU 39173 (4, 112–145), CAS-SU 39174 (1, 60.5), CAS-SU 39175 (1, 151), CAS-SU 39596 (1, 106), FMNH 47471 (5, 96*–119*), GCRL 17488 (1, 93.5), GCRL 17489 (1, 82), GCRL 20133 (4, 117–151), GCRL 20428 (14, 50–123*), UMMZ 100360 (8, 64*–146.5), USNM 78091 (4, 97–131.5), USNM 131121 (89*–126*), USNM 217521 (1, 47.5). Mindoro: CAS-SU 29812 (1, 78). Panay: GCRL 16887 (1, 51.5), GCRL 16995 (2, 51–52.5). Mindanao: USNM 133172 (1, 117).

New Subgenus *Lophocampus*

Type-species.—*Syngnathus retzii* Bleeker, 1856.

Diagnosis.—Longitudinal opercular ridge present; usually with 1–4 supplemental ridges below longitudinal opercular ridge, sometimes with 1–2 above; principal body ridges distinct; usually with at least some keeled scutella; sometimes with a supplemental ridge on side of tail; usually with distinct upper and lower ridges on pectoral-fin base, fin rounded to emarginate; pouch plates convergent in brooding males (except unknown in *M. caudocarinatus*); brood-pouch eggs in 1–3 transverse rows, sometimes in 2 layers; snout depth 2.8–5.0 in snout length; tail rings 26–32; total subdorsal rings 5.25–9.5.

Comparisons.—See characters in key, diagnoses, and discussion of subgenera.

Etymology.—From the Greek *lophos* (ridge or crest) + *kampos* (a sea-animal), in allusion to the keeled scutella typical of most species in the subgenus. Gender M.

Remarks.—The longitudinal and supplemental opercular ridges are usually distinct, and the lateral snout ridge is usually arched dorsad. Margins of principal body ridges are finely denticulate to entire in late juveniles-adults. Brooding males are unknown in *M. caudocarinatus*, but those of other species have strongly convergent pouch plates which variously meet or nearly meet on the ventral midline of the pouch. Brood-pouch eggs may be completely concealed by the pouch plates (Fig. 25) or partly exposed along the midline of the pouch (Fig. 28).

Microphis (Lophocampus) retzii (Bleeker)

Figures 25 and 26

Syngnathus Retzii Bleeker, 1856: 6, 29, 76 (orig. descr.; Manado [Celebes]); Bleeker, 1859: 187 (compiled); Bleeker, 1860a: 72 (compiled); Bleeker, 1860b: 13 (in ocean); Duméril, 1870: 550, 562 (in key, descr. compiled); Weber, 1908: 228 (Manapiri, N coast of New Guinea, freshwater); Weber, 1913: 111, fig. 37 (descr., Indonesia).

Microphis caudatus Peters, 1869b: 276 (orig. descr.; Samar I. [Philippine Is.]); Duméril, 1870: 589, 591 (in key, descr. compiled); Jordan and Seale, 1906: 214, fig. 21 (near Apia, Samoa); Jordan and Richardson, 1910: 17 (compiled); Fowler, 1918: 14 (allied with *M. philippinus*).

Syngnathus retzii. Günther, 1870: 175 (emendation, descr. compiled); Hubrecht, 1879: 51 (listed).

Doryichthys caudatus. Günther, 1870: 182 (n. comb., descr. compiled); Weber, 1908: 228 (brackish water, N New Guinea); Günther, 1910: 432 (freshwater, Samar and Java).

Doryichthys (sic) *caudatus*. Volz, 1903: 412 (compiled).

Microphis torrentius Jordan and Seale, 1906: 215, fig. 22 (orig. descr.; Vaivase River, near Vailele, E of Apia, Samoa).

Doryrhamphus caudatus. Weber, 1913: 116 (n. comb.; fresh and brackish water; distr.; Lombok, Indonesia); de Beaufort, 1913: 103 (freshwater, Indonesia).

Doryichthys Retzii. Duncker, 1915: 50 (n. comb., descr., distr.); Duncker and Mohr, 1925: 107 (Bismarck Arch., Admiralty Is., New Guinea).

Doryichthys torrentium. Duncker, 1915: 55 (n. comb., doubtful species, descr., possibly conspecific with *D. retzii*).

Doryichthys retzii. Weber and de Beaufort, 1922: 50, 52, fig. 23 (in key; descr.; distr., in part); Annandale and Hora, 1925: 38 (compared with *D. insularis*); Fowler, 1928: 112 (refs., Samoa); Fowler, 1934: 397 (New Hebrides); Herre, 1934: 28 (Batangas Prov., P.I.); Aurich, 1935: 101

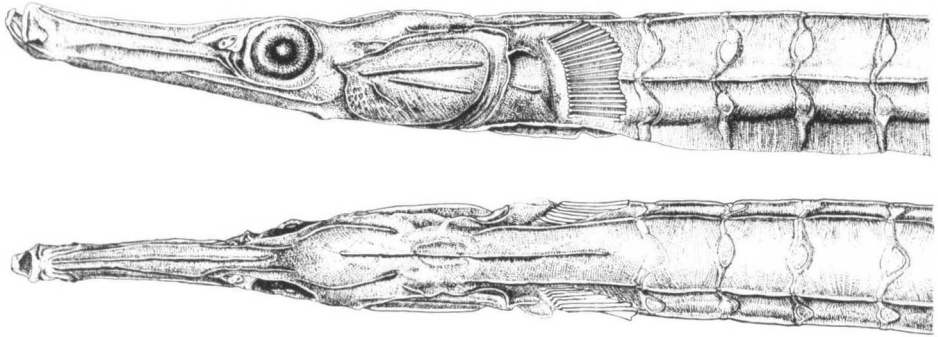


Figure 24. *Microphis jagorii*. Lateral and dorsal aspects of head and anterior trunk rings. From 143 mm SL male (GCRL 20133).

(descr., comparisons, Philippines and northern Celebes); Roxas and Martin, 1937: 76 (compiled); Herre, 1940: 203 (eats mosquito larvae); Herald, 1943: 11 (ref.); Schultz, 1943: 71, 74 (in key, Samoa); Fowler, 1949: 66 (ref.); Herre, 1953: 207 (Philippine recs.); Koumans, 1953: 204 (Indonesian recs.); Munro, 1958a: 143 (compiled); Kählsbauer, 1974: 278 (listed); Kählsbauer, 1976: 284 (data on sp. from "Port Jackson, Australia").

Doriichthys (sic) *Retzii*. Chabanaud, 1929: 168 (Amboine).

Doryichthys retzii albadorsum Fowler, 1944: 161, figs. 10–11 (orig. descr., New Hebrides); Fowler, 1949: ref.).

Doryichthys retzi. Herre, 1958: 72 (emendation, freshwater); Munro, 1967: 153, 157, fig. 260 (in key, descr.); Gray, 1974: 27, fig. (in running or stagnant water); Ryan, 1980: 61 (listed); Ryan, 1981: 93 (data on Fiji sp.).

Dorichthys (sic) *retzi*. Paxton, 1975: 445 (note on caudal fin).

Diagnosis.—Trunk rings modally 16, dorsal-fin rays 32–42, with keeled scutella on side of tail, without dark spots or ocelli on trunk.

Description.—Rings 15–17 + 27–31, pectoral-fin rays 16–20, subdorsal rings 1.5–0.25 + 6.5–9.0 = 7.25–9.5 (see Tables 2–9 for additional counts). Proportional data, based on 24 specimens 43.5–133.0 ($\bar{x}$ = 82.4) mm SL, follow: HL in SL 7.1–10.7 (9.1), snout length in HL 2.2–2.6 (2.5), snout depth in snout length 3.0–5.0 (3.5), length of dorsal-fin base in HL 0.7–0.9 (0.8), anal ring depth in HL 2.9–6.8 (4.3), pectoral-fin length in HL 4.1–6.1 (5.1). Scutella keeled on side of tail, often keeled on dorsum, side of trunk and venter of tail; side of tail usually with a supplemental ridge.

Pale to dark brown, side of snout and opercle brownish or with a dark stripe; dorsum and upper part of side of trunk sometimes with diffuse dark bars; sometimes with a diffuse dark stripe above lateral trunk ridge.

Comparisons.—*Microphis retzii* shares the presence of keeled tail scutella with *M. brevidorsalis* and *M. caudocarinatus*, but these scutella are without keels in examined specimens of *M. ocellatus*. *Microphis retzii* has fewer trunk rings than *M. caudocarinatus* (15–17 versus 20), more dorsal-fin rays than *M. brevidorsalis* (32–42 versus 25–29), and lacks the dark spots or ocelli on side of trunk which are present in *M. brevidorsalis* and *M. ocellatus*.

Types.—Bleeker's (1856) description was based on 37 specimens (60–67 mm TL), and Hubrecht (1879) listed 22 A-series specimens in the Auction Catalogue and 2 fish in each of the B through E series. I am aware of three lots of Bleeker specimens of *M. retzii*, and most of the 33 included specimens (ca. 49*–62 mm SL) are probably syntypes. Two lots (BMNH 1867.11.28.350, ZMA 115.996),

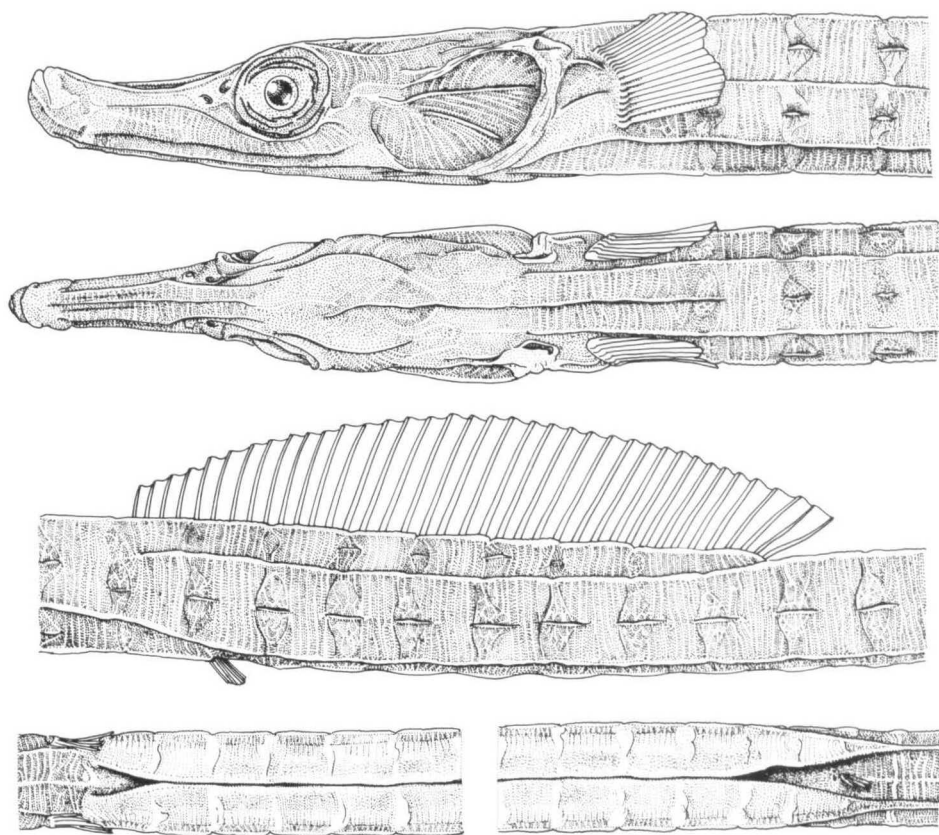


Figure 25. *Microphis retzii*. Lateral and dorsal aspects of head and anterior trunk rings, lateral section of body, and ventral aspect of brood pouch. Upper three from 68 mm SL female (ZMA 116.003), bottom from 86 mm SL male (GCRL 16272).

including 3 fish (56–62 mm SL), are here considered presumptive syntypes. The remaining lot (RMNH 7236), with 30 specimens (49*–61 mm SL), includes several small fish (51–55 mm SL) which would appear to be smaller than any of Bleeker's original material. Thus, these fish, apparently including indeterminable numbers of syntypes and non-type material, are not treated here as syntypes. This lot includes an ink-marked specimen (63.5 mm TL) which may be the model for the illustration of *Syngnathus retzii* (Pl. 450, fig. 10) in Bleeker's unpublished Atlas.

Remarks.—The smallest examined male with developed brood pouch (65.5 mm SL) is also the smallest brooding male and has a single row of 7 eggs in the pouch. Another brooding male (96.5 mm SL) has pouch eggs deposited in two layers of two transverse rows, and there are ca. 40 eggs in the right ventral row. Brood-pouch plates are usually well separated in males without eggs, but the distal margins of the opposing plates are typically in contact or closely approximated in brooding fish (Fig. 25).

The median caudal-fin rays are somewhat elongate in some planktonic young, but the fin is rounded in adults and most juveniles.

Among present material, specimens from the eastern portion of the geographic range (Ponape, Solomon Is., New Hebrides, Fiji, Samoa) tend to have fewer dorsal-



Figure 26. Upper pair: *Microphis retzii* (Bleeker). Top.—Adult female, 81.5 mm SL (WAM P.26724-001). Bottom.—Adult male, 78 mm SL (GCRL 13199). Lower pair: *M. brevidorsalis* (de Beaufort), CAS-SU 24179. Top.—Adult male, 72 mm SL. Bottom.—Adult female, 71 mm SL.

fin rays than those from other areas (32–38 versus 36–42). However, I find no evidence of significant geographic variation in other meristic values.

Distribution.—Indonesia, Philippine Is. and southeastward to Ponape and the Samoa Is. (Fig. 27). A specimen from “Port Jackson, Australia” (ZMUC 3975) is labeled incorrectly.

Among present material, one specimen (USNM 258130) is from an offshore plankton tow, several lots of juveniles were taken in harbors with nightlight and dipnet, and 38 lots of juveniles and adults are from rivers or streams. Several lots are recorded from clear, fast flowing, streams and one collection (GCRL 17466) is from an elevation of 150 m above sea level.

Material Examined.—One hundred and eighty-two specimens, 43.5–135 mm SL, including three presumptive syntypes and an undetermined number of probable syntypes.

Presumptive Syntypes.—BMNH 1867.11.28.350 (2, juveniles, 56–61) and ZMA 115.996 (juvenile, 62), presumably Manado, P. Bleeker.

Other Material.—INDONESIA, Lombok: ZMA 116.001 (5, 48–89). Sumba: ZMA 109.192 (7, 46.5–76). Flores: GCRL 16272 (2, 75–86), ZMA 109.179 (1, 91), ZMA 115.992 (2, 81–105.5), ZMA 115.993 (6, 72–90), ZMA 116.043 (1, 120). Saba: ZMA 116.002 (8, 56–61.5). Celebes: ZMA 116.003 (1, 68),

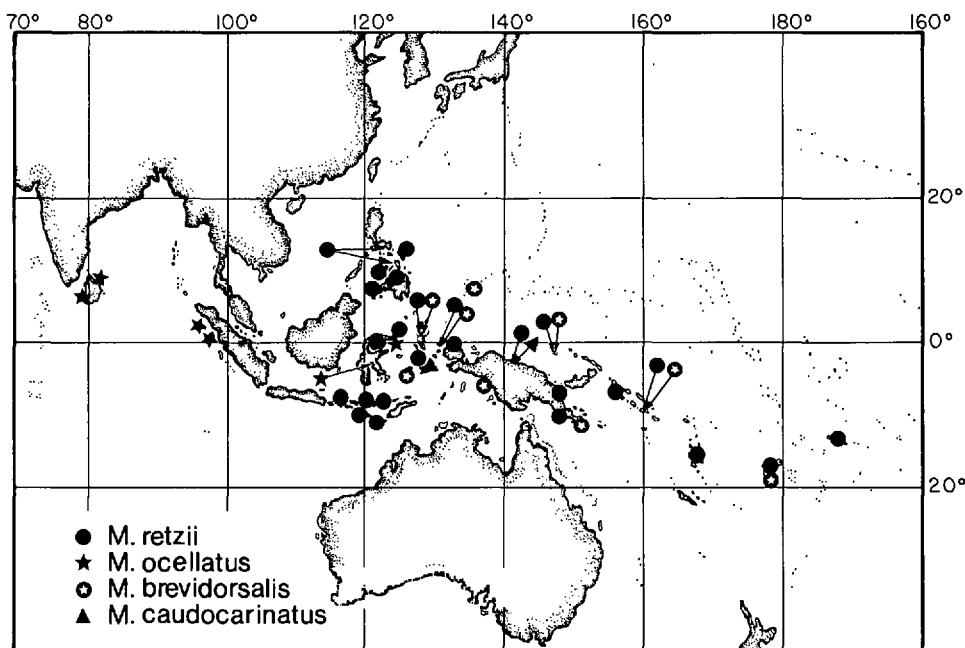


Figure 27. Distributions of species of the subgenus *Lophocampus* based on material examined.

ZMA 116.004 (21, 51.5–56.5). Halmahera: GCRL 19593 (1, 49). Obi Is.: ZMA 116.005 (1, 52.5). Ambon: USNM 215317 (2, 89–91). Ceram: FMNH 52486 (1, 106), RMNH 28752 (1, 111.5), ZMA 115.998 (2, 133–135), ZMA 115.999 (7, 103–117.5). Waigeu: USNM 222935 (1, 65), ZMA 116.009 (1, 73). Irian Jaya: RMNH 27531 (2, 52–59), RMNH 27591 (1, 66.5), ZMA 116.006 (2, 60–75), ZMA 116.007 (1, 75), ZMA 116.010 (2, 68.5–74). Loc. uncertain: MCZ 49638 (1, 91), RMNH 7236 (30, 49*–61.5, including some probable syntypes). PHILIPPINE IS., Luzon: CAS 27682 (1, 64), GCRL 16949 (3, 61–72). Catanduanes: GCRL 17466 (2, 96.5–105). Sibuyan: CAS-SU 20510 (1, 110), CAS-SU 32937 (1, 96.5). Panay: GCRL 16397 (1, 52), GCRL 16398 (1, 49), GCRL uncat. (1, 46). Negros: USNM 220650 (1, 52.5), UWCF 14061 (1, 90.5). Mindanao: CAS 52312 (1, 53), CAS-SU 39161 (1, 83.5). PAPUA NEW GUINEA: GCRL 16954 (2, 43.5–47.5), KFERS F.0125 (1, 94.5), KFERS F.01791 (1, 106.5), USNM 222934 (2, 44.5–53), USNM 258130 (1, 53), WAM P.26724-001 (1, 81.5), WAM P.27403-005 (1, 83.5), WAM P.27833-012 (2, 93*–111). Admiralty Is., Manus: USNM 143633 (3, 82–92), USNM 143636 (2, 78–78.5), USNM 215336 (1, 69*), WAM P.27829-012 (3, 80–95), WAM P.27830-014 (1, 85.5). PONAPE: GCRL 18986 (2, 91–105.5). SOLOMON IS., Guadalcanal: BMNH 1981.6.16.23 (2, 68–96), BPBM 17673 (1, 46.5), CAS 36581 (1, 47.5), USNM 215337 (2, 109–115), USNM 217522 (1, 106.5), USP uncat. (2, 49.5–50.5). NEW HEBRIDES IS.: ANSP 71351 (female, 103.5, holotype of *Doryichthys retzii albadorsum*). FIJI IS.: GCRL 13199 (1, 78), USP uncat. (7, 49.5–90). SAMOA IS., Upolu: BMNH 1926.3.6.52-54 (3, 63.5–69), CAS-SU 8970 (3, 71.5–84.5), CAS-SU 68892 (1, 70.5), USNM 51725 (male, 81, holotype of *Microphis torrentius*), USNM 61171 (2, 74–86*, paratypes of *M. torrentius*). LOC. QUESTIONABLE: ZMUC 3975 (1, 115*), Australia, New South Wales, coast at Port Jackson, 3 Mar. 1915, Mortensen.

Microphis (Lophocampus) brevidorsalis (de Beaufort)

Figures 26 and 28

Doryrhamphus brevidorsalis de Beaufort, 1913: 103 (orig. descr.; stream near Kajeli, Buru [Indonesia]); Nijssen et al., 1982: 80 (compiled).

Doryichthys brevidorsalis. Duncker, 1915: 50 (n. comb., descr. compiled); Weber and de Beaufort, 1922: 50, 51 (in key; descr.; freshwater; Lorentz River, south New Guinea); Aurich, 1935: 101 (counts; stream; Bolaang, North Celebes); Harry, 1948: 221 (comparisons, distr.); Munro, 1958a: 144 (compiled); Fehlmann, 1960: 61, 67, 92, pl. 20b (freshwater, Palau Is.); Munro, 1967: 153 (in key); Kähnsbauer, 1974: 278 (listed); Bright and June, 1981: 108 (compiled).

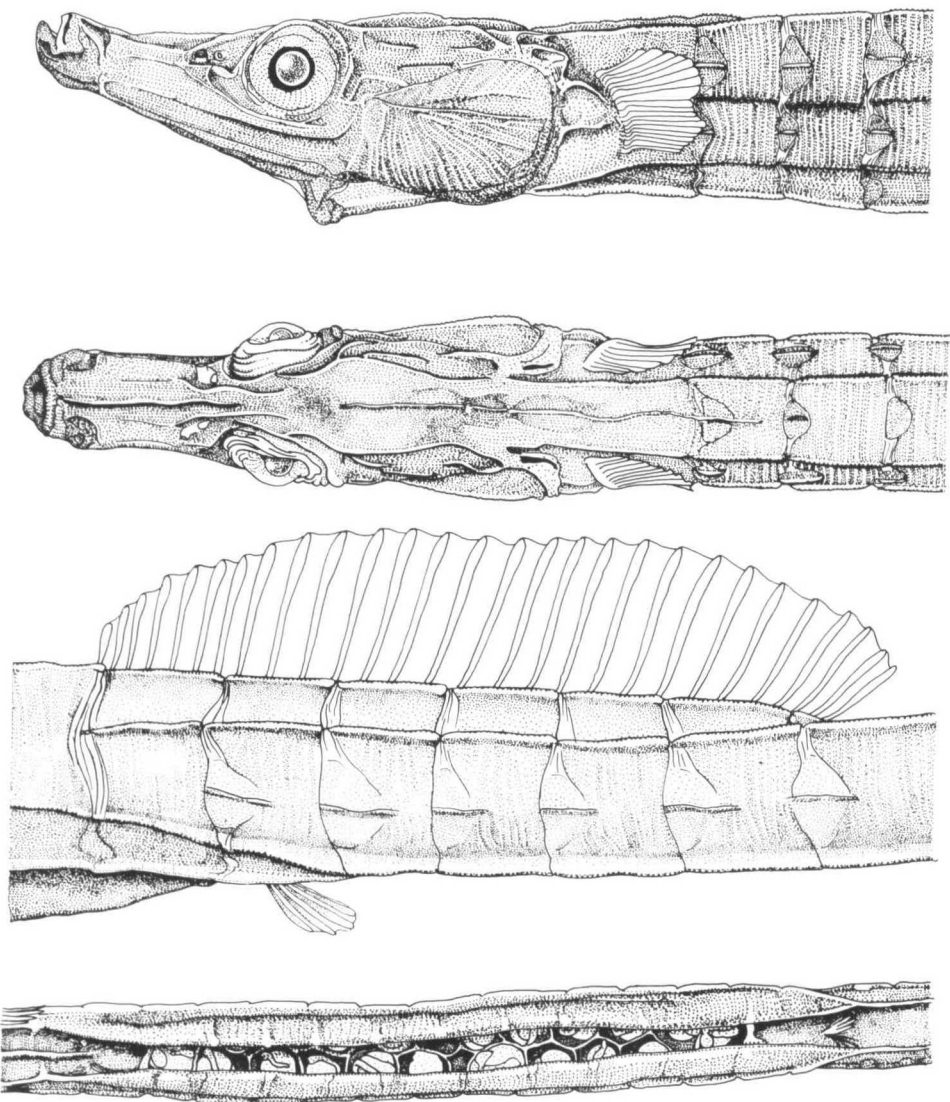


Figure 28. *Microphis brevidorsalis*. Lateral and dorsal aspects of head and anterior trunk rings, lateral section of body, and ventral aspect of brood pouch with eggs in situ. Upper three from 69.5 mm SL female, bottom from 72 mm SL male (CAS 24179).

Diagnosis.—Trunk rings modally 16, dorsal-fin rays 25–29, with keeled scutella on side of tail, with dark spots or blotches on side of trunk.

Description.—Rings $15-16 + 26-29$, pectoral-fin rays $17-21$, subdorsal rings $1.75-0.75 + 3.75-5.75 = 5.25-7.0$ (see Tables 2–9 for additional counts). Proportional data, based on 13 specimens 60.0–96.5 ($\bar{x} = 77.0$) mm SL, follow: HL in SL 7.0–9.8 (8.5), snout length in HL 2.2–2.7 (2.4), snout depth in snout length 2.8–4.6 (3.6), length of dorsal-fin base in HL 1.0–1.4 (1.2), anal ring depth in HL 3.7–4.0 (4.0), pectoral-fin length in HL 4.8–7.7 (5.8). Scutella keeled on side of trunk and

tail, often keeled on dorsum of anterior 2–4 trunk rings; side of tail sometimes with a supplemental ridge.

Largely mottled brownish, with prominent dark brown spots or quadrate blotches between rings on lateral trunk ridge (Fig. 26). Some brooding males with irregular pale bars on either side of lateral spots on trunk.

Comparisons.—*Microphis brevidorsalis* shares the presence of keeled tail scutella with *M. retzii* and *M. caudocarinatus*, but differs from these species, as well as *M. ocellatus*, in having fewer dorsal-fin rays (25–29 versus 32–42). Additionally, *M. brevidorsalis* has fewer trunk rings than *M. caudocarinatus* (15–16 versus 20), and has lateral spots on the trunk which are lacking in *M. retzii*. Lateral trunk spots are shared with *M. ocellatus*, but the spots are plain rather than ocellate in *M. brevidorsalis*.

Type.—de Beaufort (1913) described the holotype as having 16 + 28 rings, 24 dorsal- and 17 pectoral-fin rays. I find this fish, now faded and in poor condition, to have ca. 27–28 rays in the damaged dorsal fin and I count 19 rays in the left pectoral fin and 18 in the right.

Remarks.—Among examined material, the smallest male with evidence of a brood pouch is 59.5 mm SL and the smallest brooding male is 61 mm SL. The opposing brood-pouch plates are somewhat separated or in contact on the ventral midline in brooding males, and pouch eggs are deposited in a single layer of 2–3 transverse rows. One brooding male (89 mm SL) has eggs deposited in three rows with 31 in the outer right row, another (113 mm SL) has two rows of 27 eggs (ca. 1.0 mm max. diameter).

The smallest specimen examined (27 mm SL) has some keeled scutella, the principal body ridges are rather strongly elevated, and those of the tail are somewhat serrate.

Distribution.—Indonesia, western Caroline Is. and southeastward to Fiji (Fig. 27). All but one of the specimens examined are recorded from freshwater streams or rivers.

Material Examined.—Twenty-four specimens, 27–113 mm SL, including holotype.

Holotype.—ZMA 109.184 (juvenile, 41), freshwater stream near Kajeli, Buru I. (Indonesia), 9 Dec. 1909, L. F. de Beaufort.

Other Material.—INDONESIA, Halmahera: GCRL 19594 (1, 27). Waigeu: ZMA 116.051 (1, 59.5). Irian Jaya, Lorentz R.: ZMA 115.987 (3, 86.5–96.5), ZMA 116.008 (2, 70–113). PALAU IS.: CAS 39745 (1, 69), CAS 39746 (2, 76–89), CAS 39747 (2, 53.5–69.5). PAPUA NEW GUINEA, N of Maiwara: AMS I.16668-15 (1, 66). ADMIRALTY IS., Manus: USNM 143635 (1, 58*), USNM 215335 (1, 67.5), WAM P.27830-010 (2, 61–62.5). SOLOMON IS., Guadalcanal: CAS-SU 24179 (4, 69.5–81), GCRL 20453 (1, 81). FIJI IS., Viti Levu: USNM 163542 (1, 71), USNM 235770 (1, 61).

Microphis (Lophocampus) ocellatus (Duncker)

Figures 29 and 30

Doryichthys ocellatus Duncker, 1910: 28, pl. fig. a (orig. descr., Ceylon); Duncker, 1915: 51 (descr., lowland streams); Hora, 1925: 468 (compared with *D. insularis*); Mendis, 1954: 99 (compiled); De Silva, 1956: 38 (in key, descr.); Sen, 1980: 79 (ref.); Jayaram, 1981: 302 (in key).

Doryichthys retzii. Weber and de Beaufort, 1922: 52 (in part, misident.; specs. from Nias, Simalur and Paloppo only).

Dorichthys (sic) *ocellatus*. Deraniyagala, 1933: 88 (local names); Munro, 1955: 82, pl. 14, fig. 222 (in key, descr., estuarine, entering freshwater); Menon and Yazdani, 1968: 140 (syntype listed); Shiino, 1976: 107 (compiled).

Diagnosis.—Trunk rings modally 16, dorsal-fin rays 37–42, without keeled scutella on tail, with ocelli on side of trunk.

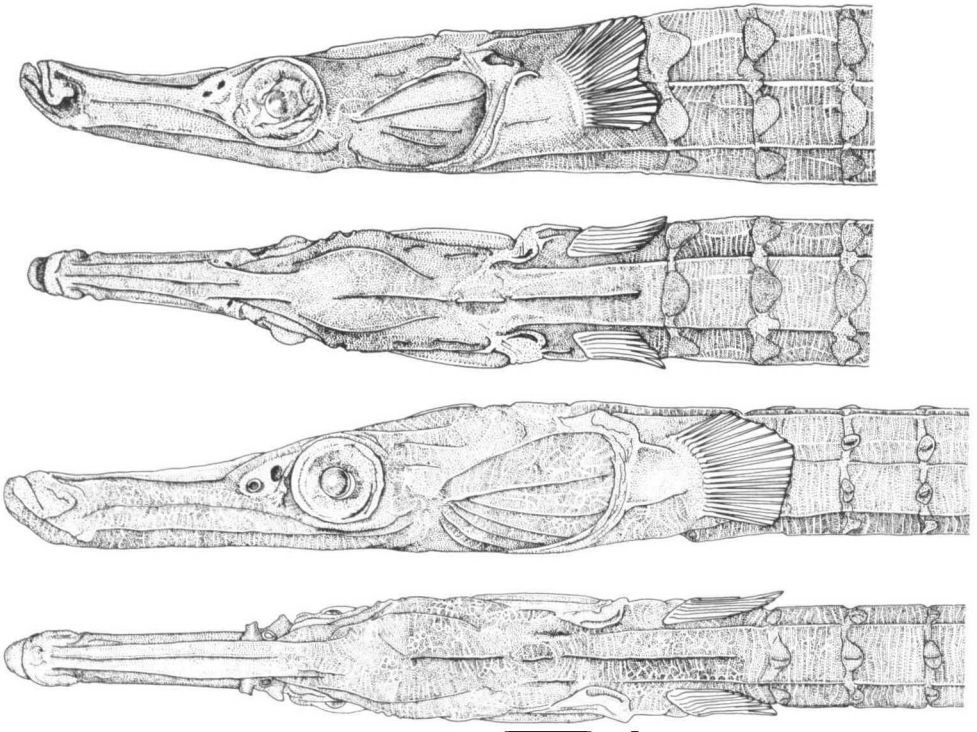


Figure 29. Lateral and dorsal aspects of head and anterior trunk rings. Upper pair: *Microphis ocellatus*, from 90.5 mm SL female (SMF 10051). Lower pair: *Microphis caudocarinatus*, from 67.5 mm SL juvenile holotype (ZMA 112.676).

Description.—Rings 15–17 + 27–32, pectoral-fin rays 17–19, subdorsal rings 1.5–0.25 + 6.5–8.0 = 7.75–8.75 (see Tables 2–9 for additional counts). Proportional data, based on 9 specimens 89.5–117.5 ($\bar{x}$ = 101.5) mm SL, follow: HL in SL 8.4–10.1 (8.9), snout length in HL 2.1–2.5 (2.3), snout depth in snout length 3.6–4.8 (4.1), length of dorsal-fin base in HL 0.8–0.9 (0.8), anal ring depth in HL 3.6–4.9 (4.1), pectoral-fin length in HL 4.5–5.7 (5.1). Scutella without keels, except 1st–2nd dorsal scutella of trunk keeled in some specimens.

Most preserved specimens with small dark spots between rings on lateral trunk ridge (Fig. 30).

Comparisons.—The absence of keeled scutella on the tail distinguishes *M. ocellatus* from other representatives of the subgenus *Lophocampus*. This species is similar to *M. retzii* in most meristic and proportional values, but clearly differs in the absence of keeled tail scutella (mostly keeled in *M. retzii*), and in the presence of dark lateral spots or ocelli (absent in *M. retzii*).

Types.—Duncker's (1910) description was based on 17 specimens (max. 130 TL) from three lowland freshwater streams in Sri Lanka. One syntype, deposited in the Colombo Museum, was destroyed during World War II (De Silva, 1956), and a similar fate befell all but one of the remaining syntypes originally deposited in the Hamburg Museum. The exception is a brooding male (ZSI F.10073/1) labeled "syntype-Ganjain, near Valvello, SW Ceylon, det. 8-8-1909, G. Duncker." This locality is not given in Duncker's description, but it may represent an incorrectly transcribed label for a specimen from one lot of 10 syntypes (orig. Hamburg Mus.



Figure 30. Top and Middle: *Microphis ocellatus* (Duncker). Top.—Brooding male, presumptive syntype, 91.5 mm SL (ZSI F.10073/1). Middle.—Adult female, 95 mm SL (GCRL 16900). Bottom.—*M. caudocarinatus* (Weber), juvenile, holotype, 67.5 mm SL (ZMA 112.676).

11,560). Duncker gave this locality as “Ginganga, at Wakwella,” and the ZSI specimen, here treated as a presumptive syntype, was apparently sent to India after 1915.

Remarks.—The smallest examined male is a brooding fish (85 mm SL) with eggs deposited in two layers and two transverse rows, and with ca. 45 eggs in the right ventral row. Opposing pouch plates are in contact on the ventral midline of the 6 brooding males examined.

Duncker (1910) noted that the dark spots on the trunk were ocellate in life, surrounded by white borders which faded in preservative.

Distribution.—Sri Lanka and Indonesia (Fig. 27). The syntypes and at least two of the other lots examined here are from freshwater rivers or streams.

Material Examined.—Thirteen specimens, 58.5–112 mm SL, including one presumptive syntype.

Presumptive Syntype.—ZSI F.10073/1 (brooding male, 91.5), Ceylon (Sri Lanka), probably from Ginganga at Wakwella, G. Duncker.

Other Material.—SRI LANKA: RMNH 20904 (1, 61.5), USNM 215311 (1, 58.5). INDONESIA, Simalur: ZMA 115.995 (1, 104.5). Nias: ZMA 115.990 (1, 98.5), ZMA 115.997 (1, 112). Celebes: GCRL 16900 (2, 95–110), SMF 10051 (4, 85–108), ZMA 115.991 (1, 89.5).

Microphis (Lophocampus) caudocarinatus (Weber)
Figures 29 and 30

Doryichthys caudocarinatus Weber, 1908: 229 (orig. descr.; freshwater, Tawarin River, northern New Guinea); Duncker, 1915: 51 (descr., brackish water); Weber and de Beaufort, 1922: 50, 51

(in key, descr.); Fowler, 1928: 112 (compiled); Munro, 1958a: 144 (compiled); Munro, 1967: 153 (in key); Kähnsbauer, 1974: 278 (listed); Nijssen et al., 1982: 80 (compiled).

Diagnosis.—Trunk rings 20, dorsal-fin rays 42, with keeled scutella on side of tail.

Description.—Rings 20 + 27, pectoral-fin rays 18–19, subdorsal rings 2.0 + 7.5. Proportional data from holotype (67.5 mm SL) follow: HL in SL 6.9, snout length in HL 2.2, snout depth in snout length 4.1, length of dorsal-fin base in HL 0.9, anal ring depth in HL 5.2, pectoral-fin length in HL 5.8. Most scutella of side and dorsum of body with distinct keels.

Comparisons.—Presence of keeled scutella on the tail is shared with *M. retzii* and *M. brevidorsalis*, but *M. caudocarinatus* differs in having more trunk rings than these species and *M. ocellatus* (20 versus 15–17).

Remarks.—The holotype is a juvenile or subadult specimen with 9 rays in the damaged caudal fin. Now bleached in preservative, it was originally described as brownish with dark shading on lower part of tail and caudal fin.

Distribution.—Known only from the holotype (ZMA 112.676) taken from fresh-water in the Tawarin River (Fig. 27), northern New Guinea (Irian Jaya), in 1903 by L. F. de Beaufort and H. A. Lorentz.

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LITERATURE CITED

- Abe, T. 1939. A list of the fishes of the Palao Islands. *Palao Trop. Biol. Sta. Stud.* 4: 523–583.
Annandale, N. and S. L. Hora. 1925. The freshwater fish from the Andaman Islands. *Rec. Indian Mus.* 27(2): 33–42.
Arnoult, J. 1959. Poissons des eaux douces. *Faune de Madagascar* 10: 1–160.
Aurich, H. 1935. Mitteilungen der Wallacea-Expedition Woltereck. *Mitteilungen XIII. Fische I.* *Zool. Anz.* 112(5/6): 97–107.
Baissac, J. de B. 1976. Poissons de mer des eaux de l'Ile Maurice. *Proc. Roy. Soc. Arts and Sci. Maurice* 3(2): 191–226.
Barnard, K. H. 1925. A monograph of the marine fishes of South Africa. *Ann. S. Afr. Mus.* 21(1): 1–418.
Beavan, R. 1877. *Handbook of the freshwater fishes of India.* L. Reeve and Co., London. x + 247 pp.
Bertin, L. and R. Estéve. 1950. *Catalogue des types de poissons du Museum National d'Histoire Naturelle. 6^e partie. Haplomes, Hétéromes, Catostéomes.* Imprimerie Nationale, Paris. 60 pp.
Blache, J. 1962. Liste des poissons signalés dans l'Atlantique tropico-oriental sud du Cap Palmes (4° lat. N.) à Mossamédès (15° lat. S.) (province guinéo équatoriale). *Cah. ORSTOM, ser. Pointe-Noire* 2: 13–102.

- , J. Cadenat and A. Stauch. 1970. Clés de détermination des poissons de mer signalés dans l'Atlantique oriental entre le 20° parallèle nord et le 15° parallèle sud. *Faune Tropicale* 18: 1–479.
- Blanc, M. 1961. Les poissons des terres australes et antarctiques françaises. *Mem. Inst. Sci. Madagascar*, Sér. F., 4: 109–159.
- Bleeker, P. 1853a. Bijdrage tot de kennis der Troskieuwige visschen van den Indischen Archipel. *Verh. Bat. Gen.* 25(6): 1–30.
- . 1853b. Nalezingen op de ichthyologische fauna van Bengalen en Hindostan. *Verh. Bat. Gen.* 25(8): 1–164 (pls. 1–6 publ. in 26: 165–166, 1854).
- . 1854. Overzicht der ichthyologische fauna van Sumatra met beschrijving van eenige nieuwe soorten. *Natuurk. Tijdschr. Ned. Ind.* 7: 49–108.
- . 1856. Beschrijvingen van nieuwe en weinig bekende vischsoorten van Manado en Makassar, grootendeels verzameld op eene reis door den Molukschen Archipel, gedaan in het gevolg van den Gouverneur Generaal Duymaer van Twist (in September en October 1855). *Act. Soc. Sci. Indo-Neerl.* 1: 1–80.
- . 1857a. Tweede bijdrage tot de kennis der ichthyologische fauna van Boero. *Natuurk. Tijdschr. Ned. Ind.* 13: 55–82.
- . 1857b. Over eenige Vischverzamelingen van verschillende gedeelten van Java. *Natuurk. Tijdschr. Ned. Ind.* 13: 475–480.
- . 1858a. Enumeratio specierum piscium Javanensium hucusque cognitarum. *Natuurk. Tijdschr. Ned. Ind.* 15: 359–456.
- . 1858b. Tiende bijdrage tot de kennis der vischfauna van Celebes. *Act. Soc. Sci. Indo-Neerl.* 3: 1–16.
- . 1858–1859. Vischsoorten van Batjan, verzameld door J. G. F. Vernelot Moens. *Natuurk. Tijdschr. Ned. Ind.* 16: 208–210.
- . 1859. Enumeratio specierum piscium hucusque in Archipelago Indico observatarum, etc. . . . *Act. Soc. Sci. Indo-Neerl.* 6: xxxvi + 276 pp.
- . 1859–1860. Visschen uit der omstreken van Tandjong aan de Samangkabai, verzameld door den heer Hunnius. *Natuurk. Tijdschr. Ned. Ind.* 20: 218–220.
- . 1860a. Achtste bijdrage tot de kennis der vischfauna van Sumatra. Visschen van Benkoelen, Priaman, Tandjong, Palembang en Djambi. *Act. Soc. Sci. Indo-Neerl.* 8: 1–88.
- . 1860b. Dertiende bijdrage tot de kennis der vischfauna van Celebes. Visschen van Bonthain, Badjao, Sindjai, Lagoesi en Pompenoea. *Act. Soc. Sci. Indo-Neerl.* 8: 1–60.
- . 1867. Quatrième notice sur la faune ichthyologique de l'île de Halmahéra. *Arch. Neerl. Sci. Nat.* 2: 397–399.
- . 1874. Poissons de Madagascar et de l'île de la Réunion. Pages 1–104 in P. Bleeker and F. P. L. Pollen, eds. *Poissons et Pêches. Recherches sur la Faune de Madagascar et de ses dépendances d'après les découvertes de François P. O. Pollen et D. C. van Dam.* E. J. Brill, Leiden.
- Boulenger, G. A. 1895. List of the freshwater fishes collected by Mr. A. Everett on Palawan and Balabac. *Ann. Mag. Nat. Hist.*, 6th ser. 15: 185–187.
- . 1915. Catalogue of the fresh-water fishes of Africa in the British Museum (Natural History). London 3: 1–526.
- Breder, C. M., Jr. and D. E. Rosen. 1966. Modes of reproduction in fishes. The Natural History Press, Garden City, N.Y. 941 pp.
- Bright, G. R. and J. A. June. 1981. Freshwater fishes of Palau, Caroline Islands. *Micronesica* 17(1–2): 107–111.
- Chabanaud, P. 1929. Remarques sur divers poissons de la famille des Syngnathidae et description de deux espèces nouvelles de l'Indie archipélagique. *Bull. Soc. Zool. Fr.* 54: 165–172.
- Daget, J. and A. Ittis. 1965. Poissons de côte d'Ivoire (eaux douces et saumâtres). *Mem. IFAN* 74: 1–385.
- Dawson, C. E. 1977. Synopsis of syngnathine pipefishes usually referred to the genus *Ichthyocampus* Kaup, with description of new genera and species. *Bull. Mar. Sci.* 27(4): 595–650.
- . 1978. Review of the Indo-Pacific pipefish genus *Bhanotia*, with description of *B. nuda* n. sp. *Proc. Biol. Soc. Wash.* 91(2): 392–407.
- . 1979. Review of the polytypic doryrhamphine pipefish *Oostethus brachyurus* (Bleeker). *Bull. Mar. Sci.* 29(4): 465–480.
- . 1981. Review of the Indo-Pacific doryrhamphine pipefish genus *Doryichthys*. *Jap. J. Ichthyol.* 28(1): 1–18.
- . 1982a. Fishes of the western North Atlantic. The pipefishes (subfamilies Doryrhamphinae and Syngnathinae). *Mem. Sears Fdn Mar. Res.* 1(8): 4–172.
- . 1982b. Synopsis of the Indo-Pacific genus *Solegnathus* (Pisces: Syngnathidae). *Jap. J. Ichthyol.* 29(2): 138–161.
- . 1982c. The pipefish name *Syngnathus uncinatus* Weber, a junior synonym of *Bhanotia fasciolata* (Duméril). *Copeia* 1982(1): 210–212.

- and P. Fourmanoir. 1981. *Microphis cruentus*, a new doryrhamphine pipefish (Syngnathidae) from New Caledonia. *Micronesica* 17(1-2): 113-118.
- and R. A. Fritzsche. 1975. Odontoid processes in pipefish jaws. *Nature* 257: 390.
- Day, F. 1865a. The fishes of Malabar. Bernard Quaritch, London. 293 pp.
- . 1865b. On the fishes of Cochin, on the Malabar coast of India. Part II. Anacanthini. *Proc. Zool. Soc. London* 1865: 286-318.
- . 1878. Fishes of India. Part IV. Wm. Dawson and Sons, London. xx + 553-778 pp.
- . 1889. The fauna of British India, including Ceylon and Burma. Fishes.-Vol. II. Taylor and Francis, London. 509 pp.
- de Beaufort, L. F. 1913. Fishes of the eastern part of the Indo-Australian archipelago with remarks on its zoogeography. *Bijdr. Nederl. Dierk. Ver. Amsterdam* 1913: 95-163.
- Deraniyagala, P. E. P. 1933. Names of some fishes from Ceylon. *Ceylon J. Sci.* 5: 79-111.
- De Silva, P. H. 1956. The order Thoracostei off Ceylon, with a list of the specimens in the Colombo Museum. *Spol. Zeylan.* 28: 35-45.
- Doha, S. 1973. Fishes of the districts of Mymensingh and Tangail. *Bangladesh J. Zool.* 1(1): 1-10.
- Dragovich, A. 1971. The food of skipjack and yellowfin tunas in the Atlantic Ocean. *Fish. Bull.* 68(3): 445-460.
- Duméril, A. 1870. *Histoire naturelle des poissons ou ichthyologie générale.* Tome second. Ganoides, dipnés, lophobranches. Librairie Encyclopédique de Roret, Paris. 624 pp.
- Duncker, G. 1910. On some syngnathids ("pipe fish") from Ceylon. *Spol. Zeylan.* 7(25): 25-34.
- . 1912. Die Gattungen der Syngnathidae. *Mitt. Naturh. Mus. Hamburg* 29(2): 219-240.
- . 1915. Revision der Syngnathidae. Erster teil. *Mitt. Naturh. Mus. Hamburg* 32: 9-120.
- and E. Mohr. 1925. Die Fische der Sudsee-Expedition der Hamburgischen Wissenschaftlichen Stiftung 1908-1909. *Mitt. Zool. Mus. Hamburg* 41: 93-112.
- Evermann, B. W. and A. Seale. 1923. Note on fishes from Guadalcanal, Solomon Islands. *Copeia* 120: 77-78.
- Fehlmann, H. A. 1960. Ecological distribution of fishes in a stream drainage in the Palau Islands. Ph.D. Thesis, Stanford Univ. 172 pp.
- Fowler, H. W. 1900. Contributions to the ichthyology of the tropical Pacific. *Proc. Acad. Nat. Sci. Phila.* 52: 493-528.
- . 1918. New and little-known fishes from the Philippine Islands. *Proc. Acad. Nat. Sci. Phila.* 70: 2-71.
- . 1922. Notes on hemibranchiate and lophobranchiate fishes. *Proc. Acad. Nat. Sci. Phila.* 73(3): 437-448.
- . 1925. Fishes of Guam, Hawaii, Samoa and Tahiti. *Bull. Bernice P. Bishop Mus.* 22: 1-38.
- . 1928. Fishes of Oceania. *Mem. Bernice P. Bishop Mus.* 10: iii + 540 pp.
- . 1931. Fishes of Oceania—Supplement 1. *Mem. Bernice P. Bishop Mus.* 11(5): 313-381.
- . 1932a. The fishes obtained by the Pinchot South Seas Expedition of 1929, with description of one new genus and three new species. *Proc. U.S. Nat. Mus.* 80(6): 1-16.
- . 1932b. Fresh-water fishes from the Marquesas and Society Islands. *Occ. Pap. Bernice P. Bishop Mus.* 9(25): 1-11.
- . 1934. Fishes of Oceania—Supplement 2. *Mem. Bernice P. Bishop Mus.* 11(6): 385-446.
- . 1936. The marine fishes of west Africa. *Bull. Amer. Mus. Nat. Hist.* 70(1): 1-605.
- . 1938. Fishes of the George Vanderbilt South Pacific Expedition, 1937. *Monogr. Acad. Nat. Sci. Phila.* 2: v + 349 pp.
- . 1943. Descriptions and figures of new fishes obtained in Philippine seas and adjacent waters by the United States Bureau of Fisheries steamer "Albatross." *Bull. U.S. Nat. Mus.* 100(2): 53-91.
- . 1944. Fishes obtained in the New Hebrides by Dr. Edward L. Jackson. *Proc. Acad. Nat. Sci. Phila.* 96: 155-199.
- . 1949. Fishes of Oceania—Supplement 3. *Mem. Bernice P. Bishop Mus.* 12(2): 37-186.
- . 1959. Fishes of Fiji. *Govt. of Fiji, Suva.* 670 pp.
- Fritzsche, R. A. 1980. Revision of the eastern Pacific Syngnathidae (Pisces: Syngnathiformes), including both recent and fossil forms. *Proc. Calif. Acad. Sci.* 42(6): 181-227.
- Gray, J. E. 1830. Illustrations of Indian zoology of new and hitherto unfigured Indian animals from the collection of General Hardwicke. Vol. 1, part 4, unpaginated. London.
- Gray, N. W. 1974. The fishes of the Solomon Islands. Part 1. The fresh and brackish water fishes of Guadalcanal. *Solomon Is. Mus. Assoc.* 45 pp.
- Günther, A. 1870. *Catalogue of fishes in the British Museum (Natural History).* London. 8: xxv + 549 pp.
- . 1880. Report on the shore fishes procured during the voyage of H. M. S. CHALLENGER in the years 1873-1876. *Rept. Sci. Res. H. M. S. CHALLENGER, Zool.* 1(6): 1-82.

- . 1910. Andrew Garrett's Fische der Südsee, beschrieben und redigiert von A. C. L. G. Günther. J. Mus. Godeffroy, Hamburg 6(17): 389–514.
- Hamilton Buchanan, F. 1822. An account of the fishes found in the River Ganges and its branches. London and Edinburgh. 405 pp.
- Harry, R. R. 1948. The distribution of the pipefish *Doryichthys brevadorsalis* (De Beaufort) in the East Indies. Copeia 1948(3): 221.
- Herald, E. S. 1940. A key to the pipefishes of the Pacific American coasts with descriptions of new genera and species. Allan Hancock Pac. Expdns. 9(3): 51–64.
- . 1943. Studies on the classification and interrelationships of the American pipefishes. Ph.D. Thesis, Stanford Univ. 339 pp.
- . 1953. Family Syngnathidae: Pipefishes. Pages 231–278 in L. P. Schultz et al., eds. Fishes of the Marshall and Marianas Islands. Bull. U.S. Nat. Mus. 202.
- Herre, A. W. (C. T.). 1931a. A list of fishes collected at Moorea, one of the Society Islands, being the first record from this island. J. Pan-Pac. Res. Inst. 6(4): 10.
- . 1931b. A check list of the fishes recorded from the New Hebrides. J. Pan-Pac. Res. Inst. 6(4): 11–14.
- . 1932. A check list of fishes recorded from Tahiti. J. Pan-Pac. Res. Inst. 7(1): 2–11.
- . 1934. Notes on fishes in the zoological museum of Stanford University. 1. The fishes of the Herre Philippine Expedition of 1931. The Newspaper Enterprise Ltd., Hong Kong. 106 pp.
- . 1935. A check list of the fishes of the Pelew Islands. Mid-Pac. Mag. Apr.–June: 163–166.
- . 1936. Fishes of the Crane Pacific Expedition. Field Mus. Nat. Hist., Zool. Ser. 21: 1–472.
- . 1940. Mosquito larvae as pipe-fish food. Copeia 1940(3): 203.
- . 1953. Check list of Philippine fishes. Res. Rept. U.S. Fish and Wildl. Serv. 20: 1–970.
- . 1958. Marine fishes in Philippine rivers and lakes. Philippine J. Sci. 87(1): 65–88.
- Hora, S. L. 1921. On some new or rare species of fish from the eastern Himalayas. Rec. Indian Mus. 22(5): 731–744.
- . 1925. Notes on fishes in the Indian Museum. XIII. On certain new and rare species of "Pipe Fish" (Fam. Syngnathidae). Rec. Indian Mus. 27(6): 460–468.
- Hubbs, C. L. 1929. *Oostethus*: a new generic name for a doryrhamphine pipefish. Occ. Pap. Mus. Zool., Univ. Michigan 199: 1–4.
- Hubrecht, A. A. W. 1879. Catalogue des collections formées et laissées par M. P. Bleeker. De Breuk and Smits, Leiden. 71 pp.
- Hureau, J. C. 1969. Remarques sur les poissons des îles Saint-Paul et Amsterdam. Bull. Mus. Nat. Hist. Nat., Paris, 2^e ser. 40(6): 1150–1161.
- Inger, R. F. 1955. Ecological notes on the fish fauna of a coastal drainage of North Borneo. Fieldiana: Zool. 37: 47–90.
- and C. P. Kong. 1962. The fresh-water fishes of North Borneo. Fieldiana: Zool. 45: 1–268.
- Jayaram, K. C. 1981. The freshwater fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka—A handbook. Zoological Survey of India, Calcutta. xxii + 475 pp.
- Jhingran, V. G. 1975. Fish and fisheries of India. Hindustan Publ. Co., Delhi. 954 pp.
- Jordan, D. S. 1919. The genera of fishes, Part II. Leland Stanford Jr. Univ. Pub., Univ. Ser. 1919: 168–284.
- and B. W. Evermann. 1896. The fishes of North and Middle America. Bull. U.S. Nat. Mus. 47(1): lx + 1240 pp.
- and R. E. Richardson. 1908. Fishes from islands of the Philippine Archipelago. Bull. U.S. Bur. Fish. 27: 233–287.
- and ———. 1910. Check-list of the species of fishes known from the Philippine Archipelago. Philippine Bur. Sci. Monogr. Publ. Fishes 1: 1–78.
- and A. Seale. 1906. The fishes of Samoa. Description of the species found in the archipelago, with a provisional check-list of the fishes of Oceania. Bull. U.S. Bur. Fish. 25: 175–455.
- , S. Tanaka and J. O. Snyder. 1913. A catalogue of the fishes of Japan. J. Col. Sci., Imp. Univ. Tokyo 33(1): 1–497.
- Jouan, H. 1863. Supplément à la description des poissons de la Nouvelle-Calédonie. Mem. Soc. Imp. Sci. Nat. Cherbourg 9: 177–187.
- Juillerat, E. 1880. Note sur un lophobranch du genre *Coelonotus*. Bull. Soc. Philom. Paris, 4^e ser. 7: 176.
- Kähsbauer, P. 1950. Beitrag zur Systematik der Syngnathiden (Pisces). Ann. Naturhist. Mus. Wien 57: 263–272.
- . 1962. Beitrag zur Kenntnis der Fischfauna von Nigeria. Ann. Naturhist. Mus. Wien 65: 139–165.
- . 1970. Beitrag zur Syngnathidenfauna von Papua (Neu Guinea). Ann. Naturhist. Mus. Wien 74: 151–157.

- . 1974. Über einige Syngnathiden aus Papua (Neu Guinea). *Ann. Naturhist. Mus. Wien* 78: 275–279.
- . 1976. Über einige Syngnathiden des Indo-Pazifischen Raumes und der Antillen. *Ann. Naturhist. Mus. Wien* 80: 281–290.
- . 1978. Über einige Syngnathiden des Indo-Pazifischen Raumes. *Ann. Naturhist. Mus. Wien* 81: 307–318.
- Kamohara, T. 1955. On some rare species of fishes from Prov. Tosa, Japan. *Rept. Usa Mar. Biol. Sta.* 2(2): 1–4.
- . 1964. Revised catalogue of fishes of Kōchi Prefecture, Japan. *Rept. Usa Mar. Biol. Sta.* 11(1): 1–99.
- Károli, J. 1882. *Prodromus piscium Asiae orientalis a Domino Joanne Xantus annis 1868–70 collectorum*. Természeti. Füzetek Budapest 5: 147–187.
- Kaup, J. J. 1853. Uebersicht der Lophobranchier. *Arch. Naturgesch.* 19(1): 226–234.
- . 1856. Catalogue of lophobranchiate fish in the collection of the British Museum. Taylor and Francis, London. iv + 80 pp.
- Kendall, W. C. and E. L. Goldsborough. 1911. Reports on the scientific results of the expedition to the tropical Pacific in charge of Alexander Agassiz, by the U. S. Fish Commission steamer "Albatross" from August, 1899 to March, 1900, Commander Jefferson F. Moser, U. S. N., commanding. XII. The shore fishes. *Mem. Mus. Comp. Zool.* 26(7): 241–343.
- Khalil, R. M. 1980. Histological studies on the kidneys of the Red Sea Syngnathiformes fishes. *Bull. Zool. Soc. Egypt* 29: 28–36.
- Klauswitz, W. 1955. *Paramicrophis schmidtii*, eine neue Seenadel aus Indien (Pisces, Syngnathidae). *Senck. Biol.* 36(5/6): 325–327.
- Koumans, F. P. 1953. Biological results of the Snellius Expedition XVI. The Pisces and Leptocardii of the Snellius Expedition. *Temminckia* 9: 177–275.
- Kuroda, N. 1951. A nominal list with distribution of the fishes of Suruga Bay, inclusive of the freshwater species found near the coast. *Jap. J. Ichthyol.* 1(5): 314–338.
- Lee, Sin-Che. 1983. The family Syngnathidae (Pisces: Syngnathiformes) of Taiwan. *Bull. Inst. Zool., Acad. Sinica* 22(1): 67–82.
- Marshall, T. C. 1964. *Fishes of the Great Barrier Reef*. Angus and Robertson, Ltd., Sydney. 566 pp.
- . 1966. *Tropical fishes of the Great Barrier Reef*. American Elsevier Publ. Co., New York. 239 pp.
- Masuda, H., C. Araga and T. Yoshino. 1975. *Coastal fishes of southern Japan*. Tokai Univ. Press, Tokyo. 379 pp. (also revised edn. 1980).
- Matsubara, K. 1955. Fish morphology and hierarchy. Part 1 (in Japanese). Ishizaki-Shoten, Tokyo. 789 pp.
- Mauge, L. A. 1978. Statut de deux Syngnathidés signalés par H. Sauvage dans la région de Madagascar en 1891. *Cybium*, 3^e ser. 3: 95–99.
- McCulloch, A. R. 1929. A check-list of the fishes recorded from Australia. Part I. *Mem. Aust. Mus.* 5: 1–144.
- and G. P. Whitley. 1925. List of fishes recorded from Queensland waters. *Mem. Qld. Mus.* 8(2): 125–182.
- Mendis, A. S. 1954. Fishes of Ceylon (a catalogue, key and bibliography). *Bull. Fish. Res. Sta., Dept. Fish. Ceylon* 2: vii + 222 pp.
- Menon, A. G. K. 1961. On a collection of fish from the Coromandel coast of India, including Pondicherry and Karaikkal areas. *Rec. Indian Mus.* 59(4): 369–404.
- . 1974. A check-list of fishes of the Himalayan and Indo-Gangetic plains. *Spec. Pub. Indian Fish Soc.* 1: 1–136.
- and G. M. Yazdani. 1968. Catalogue of type-specimens in the Zoological Survey of India, Part 2.-Fishes. *Rec. Zool. Surv. India* 61(1–2): 91–190.
- Metzelaar, J. 1919. Report on the fishes collected by Dr. J. Boeke in the Dutch West Indies 1904–1905, with comparative notes on marine fishes of tropical west Africa. A. H. Kruyt, Amsterdam. 315 pp.
- Monod, T. 1927. Contribution a la faune du Cameroun. Pisces I. Faune Col. Fr., Paris 1: 643–742.
- Munro, I. S. R. 1955. The marine and fresh water fishes of Ceylon. *Dept. External Affairs, Canberra*. 351 pp.
- . 1958a. The fishes of the New Guinea region. *Papua New Guinea Agr. J.* 10(4): 97–369.
- . 1958b. Family Syngnathidae. *Handbook of Australian fishes*, 22: 89–92. *Aust. Fish. News-letter* 17(4): 17–20.
- . 1967. *The fishes of New Guinea*. Dept. Agr., Stock and Fish., Port Moresby. 650 pp.
- Nijssen, H., L. van Tuijl and I. J. H. Isbrücker. 1982. A catalogue of the type-specimens of Recent fishes in the Institute of Taxonomic Zoology (Zoologisch Museum), University of Amsterdam, The Netherlands. *Versl. Tech. Gegevens, Univ. Amsterdam* 33: 1–173.

- Ogawa, M. 1957. On the aglomerular fishes in Japan and their kidney structures. Zool. Mag., Tokyo 66(11): 420-426.
- Ogilby, J. D. 1912. On some Queensland fishes. Mem. Qld. Mus. 1: 26-65.
- Okada, Y. 1938. A catalogue of vertebrates of Japan. Maruzen Co., Tokyo. iv + 412 pp.
- Orsi, J. J. 1974. A check list of the marine and freshwater fishes of Vietnam. Pub. Seto Mar. Biol. Lab. 21(3/4): 153-177.
- Paxton, J. R. 1975. *Heraldia nocturna*, a new genus and species of pipefish (Family Syngnathidae) from eastern Australia, with comments on *Maroubra perserrata* Whitley. Proc. Calif. Acad. Sci., 4th ser. 40(15): 439-447.
- Pellegrin, J. 1933. Les poissons des eaux douces de Madagascar et des îles voisines (Comores, Seychelles, Mascareignes). Mem. Acad. Malgache 14: 1-222.
- Peters, W. C. 1852. Diagnosen von neuen Flussfischen aus Mossambique. Monatsber. Akad. Wiss. Berlin 1852: 275-276, 681-685.
- . 1855a. Uebersicht der in Mossambique beobachteten Fische. Arch. Naturgesch. 21(1): 234-282.
- . 1855b. Uebersicht der in Mossambique beobachteten Seefische. Monatsber. Akad. Wiss. Berlin 1855: 428-466.
- . 1868. Naturwissenschaftliche Reise nach Mossambique. Zoologie. IV: Flussfische. Georg Reimer, Berlin. 116 pp.
- . 1869a. Über eine neue Untergattung der Flederthiere, so wie über neue Gattungen und Arten von Fischen. Monatsber. Akad. Wiss. Berlin 1868: 145-148.
- . 1869b. Über die Herrn Dr. F. Jagor in dem ostindischen Archipel gesammelten und dem K. zoologischen Museum übergebenen Fische. Monatsber. Akad. Wiss. 1868 Berlin 254-281.
- . 1881. Über die Verschiedenheit von *Syngnathus* (*Belonichthys*) *zambezensis* Pet. und *S. (B.) mento* Bleeker und über eine neue Art der Schlagengattung *Callophis* von den Philippinen. S. B. Ges. Naturf. Fr. Berlin 1881: 107-108.
- Pietschmann, V. 1930. Remarks on Pacific fishes. Bull. Bernice P. Bishop Mus. 73: 1-30.
- Poll, M. 1953. Poissons III. Téléostéens malacoptérygiens. Res. Sci. Expd. Oceanogr. Belge dans les eaux côtières Africaines de l'Atlantique Sud (1948-1949). 4: 1-258.
- Prashad, B. and D. D. Mukerji. 1929. The fish of the Indawgyi Lake and the streams of the Myitkyina District (Upper Burma). Rec. Indian Mus. 31(3): 161-224.
- Qureshi, M. R. 1970. Fishes of the order Syngnathiformes. Pakistan J. Sci. Ind. Res. 12: 268-271.
- Rahman, A. K. A. 1976. The freshwater pipefishes of Bangladesh, with the description of a new species. Bangladesh J. Zool. 4(2): 43-50.
- Randall, J. E. 1973. Tahitian fish names and a preliminary checklist of the fishes of the Society Islands. Occ. Pap. Bernice Bishop Mus. 24(11): 167-214.
- , G. R. Allen, Burhanuddin, M. Hutomo and O. K. Sumadhiharga. 1976. Preliminary list of fishes collected during the Rumphius Expedition II. Oseanol. Indonesia 6: 45-57.
- Regan, C. T. 1906. On the fresh-water fishes of the island of Trinidad, based on the collection, notes, and sketches made by Mr. Lechmere Guppy Junr. Proc. Zool. Soc. London 1906: 378-393.
- . 1908. Pisces. In: Godman, F. Duc., and O. Salvin, Biologia Centrali-Americana. London. Pt. 193, 203 pp.
- Reichenow, A. 1878. Ueber von der deutschen Expedition zur Loango-Küste eingegangene Reptilien und Fische. S. B. Ges. Naturf. Fr. Berlin 1878: 92-93.
- Rochebrune, A. T. de. 1880. Description de quelques nouvelles espèces de poissons propres à la Sénégalie. Bull. Soc. Philom. Paris 7(4): 159-169.
- . 1883. Faune de Sénégalie. I. Vertébrés. Octav Douin, Paris. 168 pp. (also Act. Soc. Linn. Bordeaux 6(36): 23-190).
- Roman, B. 1970. Peces de Rio Muni, Guinea Ecuatorial (Aguas dulces y Salobres). Fund. La Salle Sci. Nat., Barcelona. 295 pp.
- Roxas, H. A. and C. Martin. 1937. A check list of Philippine fishes. Tech. Bull. Dept. Agr. Commerce, Manila 6: 1-314.
- Ryan, P. A. 1980. A checklist of the brackish and freshwater fish of Fiji. S. Pac. J. Nat. Sci. 1: 58-73.
- . 1981. Records of three new freshwater fishes from the Fiji Islands. Pacific Sci. 35(1): 93-95.
- Sauvage, H. E. 1879. Mémoire sur la faune ichthyologique de l'Île Saint-Paul. Arch. Zool. Exp. Gén. Paris 8: 1-46.
- . 1891. Histoire naturelle des poissons. In A. Grandidier, Histoire physique, naturelle et politique de Madagascar. Imprimerie Nat., Paris. Vol. 16, 543 pp.
- Sawyer, F. C. 1953. The dates of issue of J. E. Gray's "Illustrations of Indian Zoology (London, 1830-1835)." J. Soc. Bibliophy. Nat. Hist. 3(1): 48-55.
- Schultz, L. P. 1943. Fishes of the Phoenix and Samoan Islands collected in 1939 during the expedition of the U. S. S. "Bushnell." Bull. U.S. Nat. Mus. 180: x + 316 pp.

- Seale, A. 1906. Fishes of the South Pacific. Occ. Pap. Bernice P. Bishop Mus. 4(1): 1-89.
- . 1935. The Templeton Crocker Expedition to western Polynesian and Melanesian islands, 1933. No. 27—Fishes. Proc. Calif. Acad. Sci., 4th ser. 21(27): 337-378.
- and B. A. Bean. 1907. On a collection of fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U. S. Army, with descriptions of seven new species. Proc. U.S. Nat. Mus. 33: 229-248.
- Sehgal, K. L. 1956. On a collection of fish from Assam. J. Bombay Nat. Hist. Soc. 53(4): 717-724.
- Sen, N. 1980. A redescription of *Doryichthys deocata* (Ham. Buch.) (Pisces: Syngnathidae). Rec. Zool. Surv. India 76: 79-82.
- and S. Choudhury. 1977. On a collection of fish from Manas wild life sanctuary (Kamrup-Assam) and adjacent area. Newsl. Zool. Surv. India 3(4): 199-204.
- Shaw, G. E. and E. O. Shebbeare. 1937. The fishes of Bengal. J. Asiatic Soc. Bengal 3: 1-317.
- Shiino, S. M. 1972. List of English names of Japanese fishes with proposition of new names. Sci. Rept. Shima Marineland 1: 1-210.
- . 1976. List of common names of fishes of the world, those prevailing among English-speaking nations. Sci. Rept. Shima Marineland 4: 1-262.
- Smith, J. A. 1867. Notice of a species of pipe-fish of the genus *Doryichthys* Kaup, probably new, recently brought from Old Calabar. Proc. Roy. Phys. Soc. Edinburgh 3: 227-228.
- Smith, J. L. B. 1934. Marine fishes of seven genera new to South Africa. Trans. Roy. Soc. S. Afr. 22(1): 89-100.
- . 1949. The sea fishes of southern Africa. Central News Agency, Capetown. 550 pp. (also, 1953, 1961 and 1965 edns.).
- . 1963. Fishes of the family Syngnathidae from the Red Sea and western Indian Ocean. Ichthyol. Bull. Rhodes Univ. 27: 515-543.
- Smith, M. M. 1975. Common and scientific names of the fishes of southern Africa. Spec. Publ. J. L. B. Smith Inst. Ichthyol. 14: 1-178.
- . 1980. Marine fishes of Maputaland. Pages 164-187 in M. N. Bruton and K. H. Cooper, Studies on the ecology of Maputaland. Rhodes Univ., Grahamstown and the Wildlife Soc., Durban.
- Snyder, J. O. 1909. Descriptions of new genera and species of fishes from Japan and the Riu Kiu islands. Proc. U.S. Nat. Mus. 36: 597-610.
- . 1912. Japanese shore fishes collected by the United States Bureau of Fisheries steamer "Albatross" expedition of 1906. Proc. U.S. Nat. Mus. 42: 487-519.
- Steindachner, F. 1903. Die Fische. Pages 409-464 in W. Kükenthal, Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. Abh. Senckenb. Naturf. Ges. Frankfurt 25.
- Sterba, G. 1959. Freshwater fishes of the world. Vista Books, London. 878 pp.
- Thys van der Audenaerde, D. F. E. 1965. List of the freshwater fishes presently known from the island of Fernando Poo. Bonn. Zool. Beitr. 16(3/4): 316-317.
- . 1967. The freshwater fishes of Fernando Poo. Verh. Kon. v. Acad. Wetens., Belge 29: 1-167.
- Tortonese, E. 1964. Contributo allo studio sistematico e biogeografico dei pesci della Nuova Guinea. Ann. Mus. Civico Stor. Nat. Genova 75: 13-98.
- Volz, W. 1903. Fische von Sumatra (*Ophichthys bleekeri*, n. sp.) (Reise von Dr. Walter Volz). Zool. Jahrb. (Abth. Syst. Geogr. u. Biol.) 19(4): 347-420.
- Weber, M. 1895. Fische von Ambon, Java, Thursday Island, dem Burnett-Fluss und von der Südküste von Neu Guinea. Pages 257-276 in R. Semon, Zoologische Forschungsreisen in Australien und dem Malayischen Archipel. Gustav Fischer, Jena. 5.
- . 1908. Süßwasserfische von Neu-Guinea. Res. Exped. Sci. Neerl. Nouvelle-Guinée en 1903. E. J. Brill, Leiden. 5(2): 201-268.
- . 1913. Die Fische der Siboga-Expedition. Siboga Expdn. Monogr. 57: xii + 710 pp.
- and L. F. de Beaufort. 1922. The fishes of the Indo-Australian Archipelago. E. J. Brill, Leiden. 4: 1-410.
- Wheeler, A. C. 1975. Fishes of the world. Macmillan Publ. Co., Inc., New York. 366 pp.
- Whitley, G. P. 1927. A check-list of fishes recorded from Fijian waters. J. Pan-Pac. Res. Inst. 2(1): 3-8.
- . 1964. A survey of Australian ichthyology. Proc. Linn. Soc. New South Wales 89(1): 11-127.
- and J. Allan. 1958. The sea-horse and its relatives. Georgian House, Melbourne. 84 pp.

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